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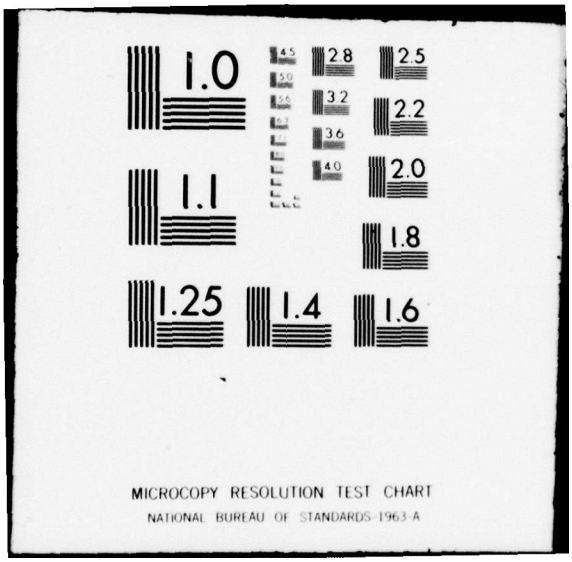
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See back page for 1473

HIGHLAND LAKE DAM

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

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NJ 00240

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

AUGUST 1978

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

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Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

26 SEP 1978

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Highland Lake Dam in Passaic County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Highland Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure, as a result of this inspection, is judged to be in poor overall condition. The spillway is considered inadequate since 37 percent of the Probable Maximum Flood (PMF) would overtop the dam. To insure adequacy of the structure, the following actions, as a minimum are recommended:

a. The adequacy of the spillway should be determined by a qualified professional consultant, engaged by the owner, using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1979.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the composition and structural stability of the dam. Any remedial measures found necessary should be initiated within calendar year 1979. Engineering studies and analyses should also be performed to evaluate the capability of the large downstream parking lot to act as a dam and reduce downstream damages and loss of life in the event of failure of the Highland Lake Dam.

c. The following actions should be taken within the indicated time from the date of approval of this report.

(1) Within three months the valve box should be cleared of all debris and the low level outlet and the gate valve should be repaired or replaced.

(2) Within six months a program for regularly observing seepage should be implemented.

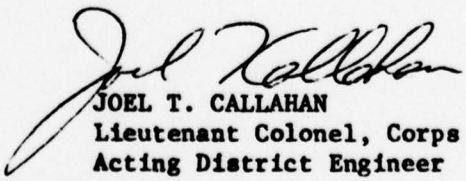
(3) Within one year a drain should be provided through the wall of the valve box and the deteriorated facing of the drain should be repaired.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Joseph Minish of the Eleventh District. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia, 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely yours,



JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

1 Incl
As stated

Cy furn:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
P.O. Box 2809
Trenton, NJ 08625

HIGHLAND LAKE DAM (NJ00240)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 29 June and 6 July 1978 by Harris-ECI under contract to the State of New Jersey. The state, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

The Highland Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure, as a result of this inspection, is judged to be in poor overall condition. The spillway is considered inadequate since 37 percent of the Probable Maximum Flood (PMF) would overtop the dam. To insure adequacy of the structure, the following actions, as a minimum are recommended:

a. The adequacy of the spillway should be determined by a qualified professional consultant, engaged by the owner, using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1979.

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c. The following actions should be taken within the indicated time from the date of approval of this report.

(1) Within three months the valve box should be cleared of all debris and the low level outlet and the gate valve should be repaired or replaced.

(2) Within six months a program for regularly observing seepage should be implemented.

(3) Within one year a drain should be provided through the wall of the valve box and the deteriorated facing of the drain should be repaired.

APPROVED: Joel T. Callahan

JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

DATE: 26 September 1978

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Highland Lake Dam, I.D. NJ00240
State Located:	New Jersey
County Located:	Passaic
Stream:	Slippery Rock Brook
Date of Inspection:	June 29, and July 6, 1978

Assessment of General Condition

Highland Lake Dam is in poor condition with serious loosening of brick facing and spalling of gunite facing at the right abutment contact, and considerable leakage from drainholes in the gunite. The low level outlet is abandoned and the valve buried by gravel in the valve vault at the toe of the dam. However, a massive earthfill constructed in the early 1970's to provide a parking lot for the Bank of New Jersey office building provides substantial protection against loss of life and extensive property damage.

Highland Lake Dam does not have an adequate spillway capacity to pass the PMF, or even one-half of the PMF without overtopping. The dam's present spillway capacity can pass only about 36 percent of the PMF.

At present the engineering data available is not sufficient to make a definitive statement on the stability of the structure.

Nevertheless, even though the spillway capacity is inadequate and it is not possible, with the information which was available, to adequately assess the structural integrity of the dam, it is felt that the parking lot retaining wall and associated earthfill, which is subsequently discussed in this report, provides a substantial check against loss of life and excessive property damage by catastrophic failure of the dam.

The following remedial actions, however, are suggested along with a timetable for their completion.

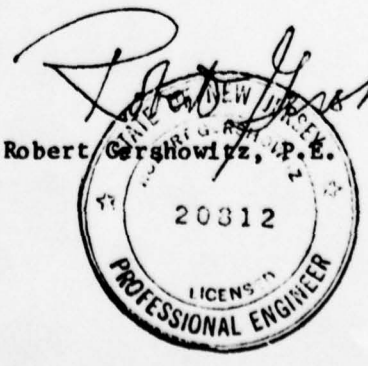
1. The valve box should be cleared of all debris. The low level outlet and the gate valve itself should be repaired or replaced within 3 months, to ensure a reliable operational drawdown facility.

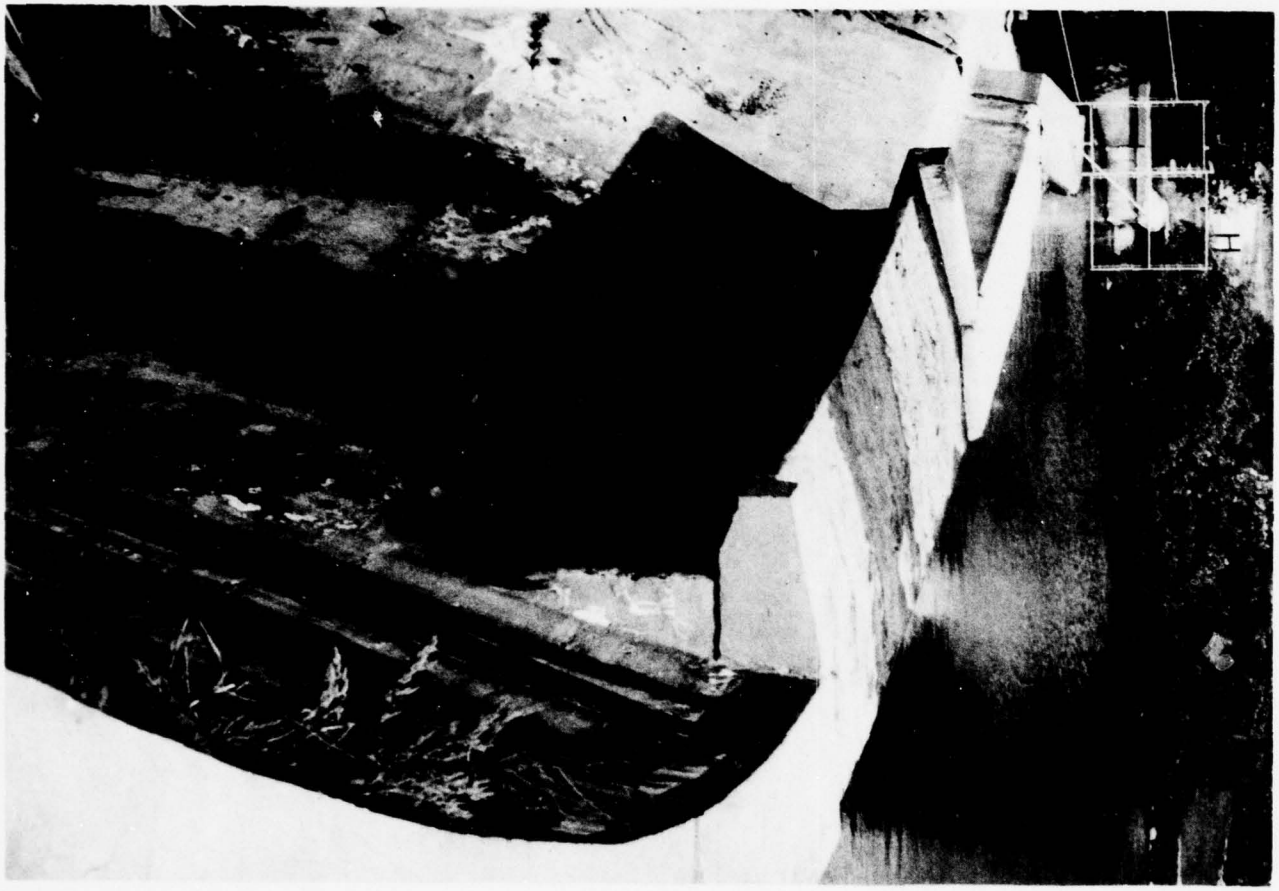
2. A program for regularly observing seepage should be implemented within six six months.

Furthermore, while of a less urgent nature, the following additional action is recommended and should be carried out within a reasonable period of time.

1. Any water entering the valve box, through stem leakage or through the dam itself, should be allowed to drain through a separate line leading out of the valve box. Therefore, a drain should be provided through the wall of the valve box.

Robert Gershowitz, P.E.





HIGHLAND LAKE
Dam and main spillway; service spillway is on right abutment at far shoreline.

June 29, 1978

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CHECK LIST - ENGINEERING, CONSTRUCTION MAINTENANCE DATA

APPENDIX B - PHOTOGRAPHS

APPENDIX C - SUMMARY OF ENGINEERING DATA

APPENDIX D - HYDROLOGIC COMPUTATIONS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

HIGHLAND LAKE DAM, ID. NJ00240

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act (Public Law 92-367, 1972) provides for the National Inventory and Inspection Program by the U.S. Army Corps of Engineers. This inspection was made in accordance with this authority under contract C-FPM No. 35 with the State of New Jersey who, in turn, is contracted to the Philadelphia District of the Corps of Engineers.

b. Purpose of Inspection

The visual inspection of the Highland Lake Dam was made on June 29, and July 6, 1978. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the Field Inspection; presents an evaluation of hydrologic and hydraulic conditions at the site; presents an evaluation as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

1.2 Description of Project

a. Description of Dam and Appurtenances

The original Highland Lake Dam, which remains in large part, is believed to be a stone masonry dam with brick facing. At a point some time ago, the brick facing was covered over with a coating of gunite varying in thickness from about 1-1/2 inches to more than 8 inches. The dam has a curved axis of about 104 feet long and a maximum height of 40 feet. The crest of the dam is covered with a concrete cap slab five feet wide.

The abutments are massive basalt rock on nearly vertical slopes. The dam is believed to be founded on the same basalt rock.

A concrete wing wall on the left abutment is backfilled with earth on the downstream side. The concrete wing wall is a concrete gravity structure with 2'-0" wide top and varies in height from zero to 10'-9" high. A similar concrete gravity wing wall extends from the service spillway on the right abutment.

The emergency spillway is a crest weir overshoot type located just right of the center of the dam. The chute slab is 26 feet wide and projects 5 feet from the downstream edge of the crest. The service spillway is a flat slab 18 feet wide and 22 feet long on the right abutment. The flows from the service spillway are discharged onto and flows as a waterfall down the right abutment rock. Both spillways are unregulated.

The low level outlet works is a 12-inch cast iron pipe through the base of the dam and just to the left of the center. A gate valve in a concrete valve vault at the base of the dam controls the outlet discharge.

b. Location

Highland Lake Dam is located in Passaic County, New Jersey. It is accessible by way of Highway 80 and either Squirrelwood Road or New Street. The parking lot for the Bank of New Jersey is located immediately downstream of the dam.

c. Size and Hazard Classification

Highland Lake Dam is classified in the dam size category as being "Intermediate", since its storage is less than 1,000 acre-feet, but its height is 40 feet. Since failure of the dam could cause loss of life and extensive property damage, a hazard potential classification of "Significant" has been assigned to the project. The dam was initially rated "High" hazard, but was downgraded after the field inspection, due to the presence of the fill downstream of the dam used to construct the parking lot.

d. Ownership

Highland Lake Dam is owned by the Bank of New Jersey, N.A., Post Office Box 2177, Patterson, New Jersey.

e. Purpose of Dam

The single present purpose of Highland Lake Dam is to retain the lake for aesthetic landscape around the Bank of New Jersey building.

f. Design and Construction History

No drawings or computations pertaining to the original construction could be found. No data from soil borings, soil tests, or other geotechnical data is available. The 1945 Plan of Repairs to Highland Lake Dam indicates that the original structure was constructed of stone masonry with earth backfill. A brick facing was constructed over the stone masonry. No cross sections of the original dam were available.

The Highland Lake Dam was damaged by a flood wave due to failure of Barbour's Pond dike in July 25, 1945 floods. The repairs and modifications to the dam included extending the spillway, new wing walls at both ends of the spillway, guniting both faces of dam, and protection of downstream toe of the dam.

Construction of the parking lot for the New Jersey Bank building has effectively created a second dam a few feet downstream of the Highland Lake Dam. The parking lot is nearly as high as Highland Lake Dam and was constructed by

building a high reinforced concrete retaining wall about 25 to 30 feet downstream of, and about parallel to, the dam and filling the gorge downstream of the retaining wall with earth. The space between the dam and the retaining wall was left unfilled leaving the dam exposed to view.

The spillways discharge into the void between the dam and parking lot. A six foot diameter concrete pipe culvert through the base of the retaining wall carries the spillway discharges under the parking lot. A concrete lined channel connects between the parking lot culvert and a similar culvert under Highway 80.

g. Normal Operational Procedures

The normal discharge from the lake is over the unregulated spillway and is allowed to naturally balance discharge with inflow to the lake. Due to the wide spillway, the normal depth of discharge is very shallow keeping the water level in the lake very stable. Since the low level outlet valve is inaccessible, it is not presently possible to lower the lake level below the spillway crest.

1.3 Pertinent Data

a. Drainage Area - 0.76 square miles

b. Discharge at Damsite

Maximum known flood at damsite	N.A.
Warm water outlet at pool elevation	N.A.
Diversion tunnel low pool outlet at pool elevation	N.A.

Diversion tunnel outlet at pool elevation	N.A.
Gated spillway capacity at pool elevation	N.A.
Gated spillway capacity at maximum pool elevation	N.A.
Ungated spillway capacity at maximum pool elevation	1,400 cfs (El. 237.82)
Total spillway capacity at maximum pool elevation	1,400 cfs

c. Elevation (Feet above MSL)

Top of dam (Top of East Wingwall)	237.82
Maximum pool-design surcharge	237.82
Full flood control pool	N.A.
Recreation pool	235.22
Spillway crest (both spillways)	235.22
Upstream portal invert diversion tunnel	N.A.
Downstream portal invert diversion tunnel	N.A.
Streambed at centerline of dam	215 feet (Estimated)
Maximum tailwater	N.A.

d. Reservoir

Length of maximum pool	1,000 ± feet (Estimated)
Length of recreation pool	920 ± feet (Estimated)
Length of flood control pool	N.A.

Design surcharge	64.5 acre-feet (El. 237.82)
Top of dam	64.5 acre-feet (El. 237.82)

f. Reservoir Surface (Acres)

Top of dam	6 ± acres (El. 237.82)
Maximum pool	6 ± acres (El. 237.82)
Flood control pool	N.A.
Recreation pool	5.7 ± acres (El. 235.22)
Spillway crest	5.7 ± acres (El. 235.22)

g. Dam

Type	Stone Masonry
Length	104 feet
Height	40 feet
Top width	5 feet
Side slopes	N.A.
Zoning	N.A.
Impervious core	N.A.
Cutoff	N.A.
Grout curtain	N.A.

h. Diversion and Regulating Tunnel (N.A.)

i. Spillways (Service and Emergency)

Types	Overflow

(Combined length of weir)	44 feet (Length of lowest portion)
Crest elevations	235.22
Gates	N.A.
Upstream channel	Reservoir
Downstream channel	6 foot diameter culvert

j. Regulating Outlets

12-inch cast iron pipe (inoperable)

SECTION 2: ENGINEERING DATA

2.1 Design

No drawings or computations pertaining to original construction could be found. No data from soil borings, soil tests or other geological data is available. Drawings showing modifications to the dam were obtained from the New Jersey Department of Environmental Protection and are included in this report.

2.2 Construction

No records have been found as to the construction history of the dam. The owner's representative has no knowledge of, and does not know anyone having knowledge of, the construction history of the dam.

2.3 Operation

No records of operation of the lake are kept by the owner. The impoundment is allowed to operate naturally without regulation.

2.4 Evaluation

a. Availability

The availability of engineering data is very poor. The only data available are the drawings pertaining to modifications to the dam and spillway, which can be obtained from the New Jersey Department of Environmental Protection.

b. Adequacy

The available engineering data is not sufficient to perform a comprehensive, definitive stability analysis of the structure. Data needed to fully assess the stability of the dam includes:

1. Subsurface information at the damsite, including engineering properties and parameters.

2. Cross sections of the structure.

3. Engineering properties of the masonry wall and earthfill.

A check list of enginering construction and maintenance is included in Appendix A.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

At the time of inspection the dam did not reveal any signs of distress. The inspection revealed that the structure is in a serviceable condition, but a regular program of inspection and repair is required to maintain its serviceability.

b. Dam

The face of the dam consisted of 2 to 6 inches of gunite with a grid of 1 inch diameter weep holes, many of which were discharging small quantities of clean water. It was determined, from an area where the gunite had broken away, that the original face of the dam was brick. The brick in this location, about four tenths of the height of the dam from the base at the right abutment, had become very loose at its contact with the abutment. A void, about 10 inches deep, has developed behind the gunite in this area. Considerable spalling of the gunite has occured, particularly near the right abutment.

The right and left abutments are basalt and outcrops are frequently encountered along the rim of the impoundment. It is believed that the dam is founded on rock.

A prominent joint set exposed in the left abutment area strikes N5°E, and dips 80°SE and has a joint spacing of 1 to 3 feet. This joint set parallels a fault, mapped by others, about one-half mile east of the dam. Near the base of the dam, downstream of the left abutment, this prominent joint set is opened a maximum of 4 inches and average about 1-1/2 inches along a joint trace of 25 feet. (This feature is believed to be due to stress relief.) The rock in this area is broken by two additional joint sets mutually perpendicular, irregularly spaced (average-3 feet) and having variable trace lengths (average-less than 1 foot).

c. Appurtenant Structures

At the time of this inspection, the gate valve box was flooded and a slight flow out of the manhole cover was observed. The source of leakage could not be determined. In addition, the manhole cover was broken in a number of pieces and the valve box was partially filled with broken stone and other miscellaneous pieces of debris. This debris was piled up to within one foot of the manhole and completely covered the valve. At present the valve is not accessible and cannot be relied on to operate properly.

The concrete wing wall structures are in excellent condition. No settlement, tilting or misalignment were evident, and no structural cracks or spalling of concrete in the walls were found.

The spillways are serviceable, moderately rough and exhibit no serious evidence of damage or distress.

d. Reservoir Area

About 60% of the impoundment is gently sloping, grassed shoreline. The remaining 40% is moderate to steep and no evidence of slope instability was readily apparent.

The original impoundment has been reduced in size with dumped rock rubble from the excavation for the bank building. Additional material dumped into the impoundment has separated off a small portion of the upstream end of the pond.

e. Downstream Channel

The dam does not have a conventional downstream channel. Spillway discharge is carried off through 272 feet of 6 foot diameter concrete culvert beneath the bank parking lot. This culvert discharges into another 6 foot diameter concrete culvert which lies under U.S. Route 80.

3.2 Evaluation

Based on the visual inspection the dam appears to be functioning adequately. Some maintenance is in order and recommendations are presented in subsequent sections. The impoundment slopes show no apparent signs of instability and are not believed a potential hazard to the dam.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

Highland Lake is presently used to impound water for esthetic reasons only. The lake level is normally maintained by unregulated discharge over the service spillway in the right abutment. The other spillway releases excess flow during storms.

The low level outlet is inoperable and the impoundment, therefore, cannot be drained.

4.2 Maintenance of the Dam

There is no program of regular inspection and maintenance of the dam and appurtenant structures. Operation and maintenance is the responsibility of the New Jersey Bank, owner of the dam. At present, no records of operation and maintenance are kept.

4.3 Maintenance of Operating Facilities

The low level outlet gate valve is inoperable. No known maintenance of the valve has been made to keep the valve operable. The outlet pipe has not received maintenance.

4.4 Evaluation

A formalized program of periodic inspection by an experienced party should be initiated and documentation recorded. If the dam is to continue to function in its present capacity the low level outlet and gate valve should be restored to an effective operational capacity.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The drainage area above the Highland Lake Dam on the Slippery Rock Brook is approximately 0.76 square miles. A drainage map of the watershed of Highland Lake damsite is presented on Plate 1, Appendix D.

The topography within the basin varies from foothills type terrain in the upper section to generally hilly in the lower section. Elevations range from approximately 235 feet above mean sea level at the damsite to over 495 feet above mean sea level in the upper end of the watershed. U.S. Highway 80 is about a quarter mile downstream from the Highland Lake Dam.

Land use patterns within the watershed are mostly urban with some forested lands in the hilly section of the basin. Most of the urban areas are located near the rim of the reservoir and in the lower elevation portion of the watershed.

The evaulation of the hydraulic and hydrologic features of Highland Lake Dam was based on criteria set forth in the Corps guidelines and additional guidance provided by the Philadelphia District, Corps of Engineers. The Probable Maximum Flood (PMF) was calculated from the Probable Maximum Precipitation using Hydrometeorological Report No. 33 with standard reduction factors. Due to the small drainage area of

this dam, the SCS triangular hydrograph, transformed to a curvilinear hydrograph, was adopted for developing the unit hydrograph. The derived unit hydrograph is presented in Appendix D.

Initial and infiltration loss rates were applied using SCS procedure to the Probable Maximum Storm rainfall to obtain rainfall excesses. The rainfall excesses were then applied to the unit hydrograph to obtain the PMF hydrograph utilizing program HEC-1.

The computed peak discharge of the PMF and one-half the PMF are 3,826 cfs and 1,913 cfs, respectively.

Both the PMF and one-half the PMF inflow hydrographs were routed through the reservoir by the Modified Puls Method, also utilizing computer program HEC-1. The peak outflow discharges for the PMF and one-half the PMF are 3,793 cfs and 1,889 cfs, respectively. Both the PMF and one-half the PMF result in overtopping of the dam.

The stage-outflow relation for the spillway was prepared from field notes, sketches and limited construction drawings. The reservoir stage-capacity data were based on the U.S.G.S. quadrangle topographic maps in combination with data given in the National Dam Safety Inventory Table. Reservoir storage capacity include for surcharge levels exceeding the top of the dam and the spillway rating curve assumed that the dam remains intact during routing. In the routing computations, the discharge through outlet facilities was excluded due to its being inoperable. The spillway rating curve and the reservoir capacity curve are presented in Plates 2 and 3 of Appendix D, respectively.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site. However, according to interviews with local residents, the maximum reservoir level was never higher than the dam crest.

c. Visual Observation

The small watershed and reservoir is located in a well developed urban area. There is no evidence of excessive sedimentation due to recent developments in the drainage basin which could cause a sudden increase in sediment load, which may pose danger to the dam.

d. Overtopping Potential

As indicated in Section 5.1-a., both the Probable Maximum Flood and one-half the Probable Maximum Flood, when routed through Highland Lake Reservoir result in overtopping of the dam. The PMF and one-half the PMF overtopped the dam by 2.00 feet and 0.60 feet, respectively.

The spillway is only capable of passing a flood equal to approximately thirty-six percent of the PMF without overtopping the dam. Since one-half the PMF is the minimum Spillway Design Flood (SDF) for this dam, according to the Recommended Guidelines for Safety Inspection of Dams by the Corps of Engineers, the spillway capacity of the Highland Lake Dam is considered "Inadequate".

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

At the time of the inspection there were no readily apparent signs of instability in the structure. The abutments also appeared structurally competent. The spillways did not exhibit visual evidence of misalignment or structural cracking.

b. Design and Construction Data

No design computations were uncovered during the report preparation phase. No cross sections of the original masonry were available. The dimensions of the masonry wall, and extent of earthfill behind the wall, are undefined. No construction records or as-builts were available.

c. Operating Records

No operating records are available relating to the stability of the dam. The structure has apparently served satisfactorily since it was repaired in 1945.

d. Post-Construction Changes

It is not clear, from available drawings, just what the original section consisted of. A flood wave, caused by failure of an upstream dike during a storm in 1945, overtopped the dam and wingwalls eroding the soil in the abutments down

to bedrock. Damage to the structure, if any, was not reported. Repairs to the structure were undertaken in 1945, however, the plans do not shed any light on the original cross section.

f. Seismic Stability

A prominent joint set exposed in the left abutment areas strikes N5°E, dips 80°SE and has a joint spacing of 1 to 3 feet. This joint set parallels a fault, mapped by others, about one-half mile east of the dam. The dam is located in Seismic Zone 1, as defined in Recommended Guidelines For Safety Inspection of Dams as prepared by the Corps of Engineers. In general, projects located in Seismic Zones 0, 1 and 2 may be assumed to present no hazard from earthquake, provided the static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The dam has been inspected visually and a review has been made of the available engineering data. This assessment is subject to the limitations inherent in the visual inspection procedures stipulated by the Corps of Engineers for a Phase I report.

Highland Lake Dam does not have an adequate spillway capacity to pass the PMF or one-half of the PMF without overtopping. The dam's present spillway capacity can pass only about 36 percent of the PMF.

No definitive statement pertaining to the safety of the dam can be made without determination of the cross sectional dimensions of the dam and acquisition of the engineering properties of the masonry and earthfill section. The present dam, however, has performed adequately since its repair in 1945 without failure or evidence of instability. Further, it should be noted that the dam structure survived a flood wave in 1945 whose high water mark was later measured to be 2.75 feet above the dam's crest.

Nevertheless, the outstanding feature which provides substantial protection against loss of life and extensive property damage in the event of failure of Highland Lake Dam is the present parking lot immediately downstream of the dam. The parking lot, constructed in the early 1970's,

sits over a massive earthfill. A reinforced concrete retaining wall, 29.5 feet high, was constructed 25 to 30 feet from the dam and effectively encloses the structure. A 6 foot diameter concrete pipe culvert lies beneath the parking lot to carry dam discharges. In the event of a flood, the space between the dam and retaining wall will tend to fill with water until the culvert can accommodate the inflow or until the retaining wall is overtopped. Flooding of this space will produce hydrostatic pressure against the downstream face of the dam and increase the stability of the structure. In the event of actual failure of the structure, the retaining wall will act as a second dam, effectively limiting the release of the impoundment. It is quite possible that the culvert may even become clogged with debris from the failed structure and, thus, further retard the release of the impoundment, exclusive of that portion that might flow over the parking lot.

Therefore, even though the spillway capacity is inadequate and it is not possible, with the information which was available, to adequately assess the structural integrity of the dam, it is felt that the parking lot retaining wall and associated earthfill provides a substantial check against loss of life and excessive property damage by catastrophic failure of the dam.

Another inadequacy, at present, is the inability to lower the lake level due to inaccessibility to the control valve.

b. Adequacy of Information

The information and data uncovered is not adequate to perform a comprehensive, definitive evaluation of the dam's stability. Nevertheless, in view of the past performance of the dam, its present condition, and in light of the massive earthfill parking lot downstream it is not felt that additional information on the engineering properties of the embankment and foundation materials is necessary at this time.

c. Urgency

The valve box should be cleared of all debris. The low level outlet and the gate valve itself should be repaired or replaced within 3 months, to ensure a reliable operational drawdown facility.

A program for regularly observing seepage should be implemented within six months.

7.2 Remedial Measures

a. Alternatives

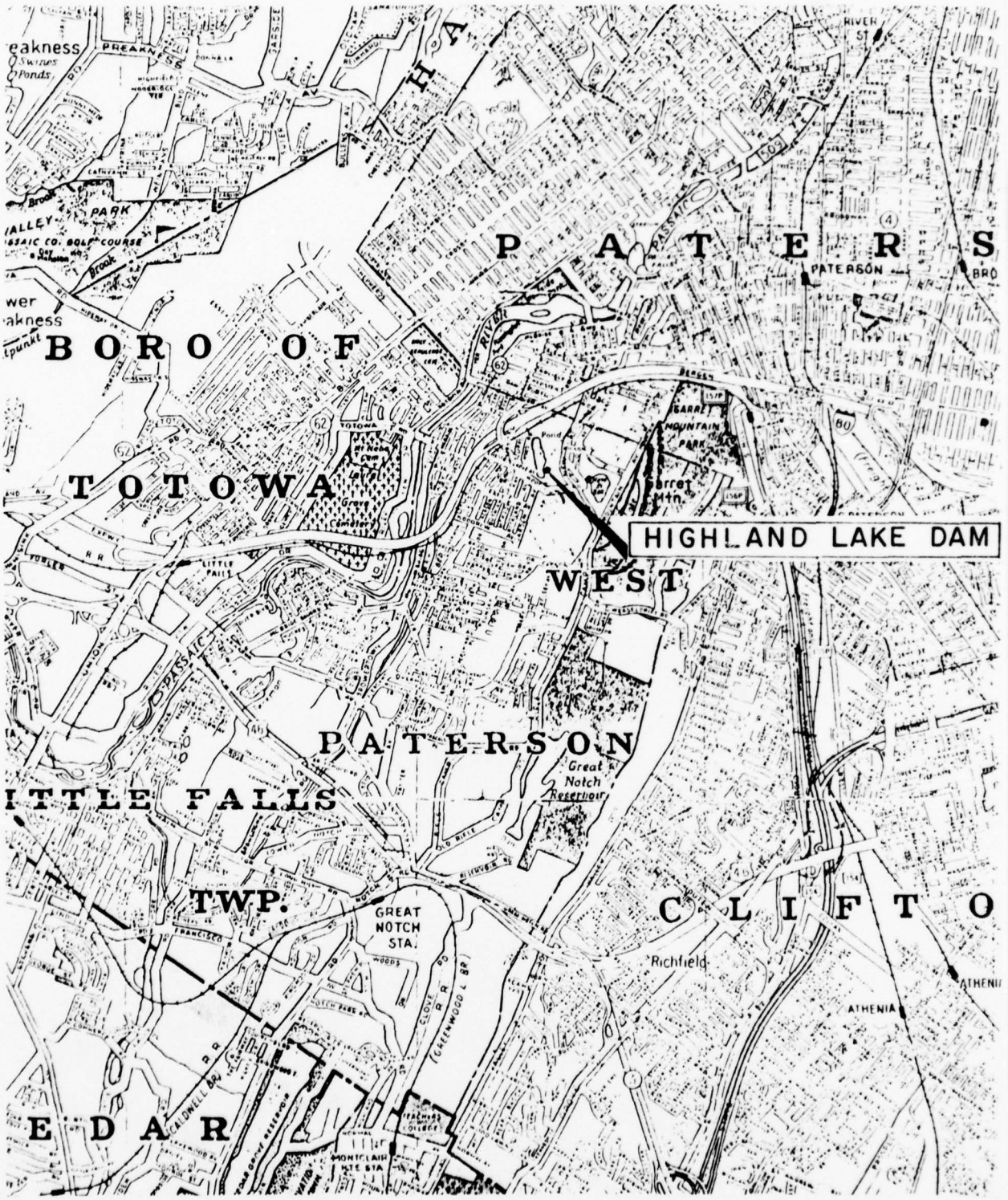
There is no real alternative to cleaning out the valve vault and making any necessary repairs to the control valve to make the low level outlet operable.

7.3 Recommendations

Normally, any water entering the valve box, through stem leakage or joint leakage or through the dam itself, should be allowed to drain through a separate line leading out of the valve box. Therefore, a drain should be provided through the wall of the valve box.

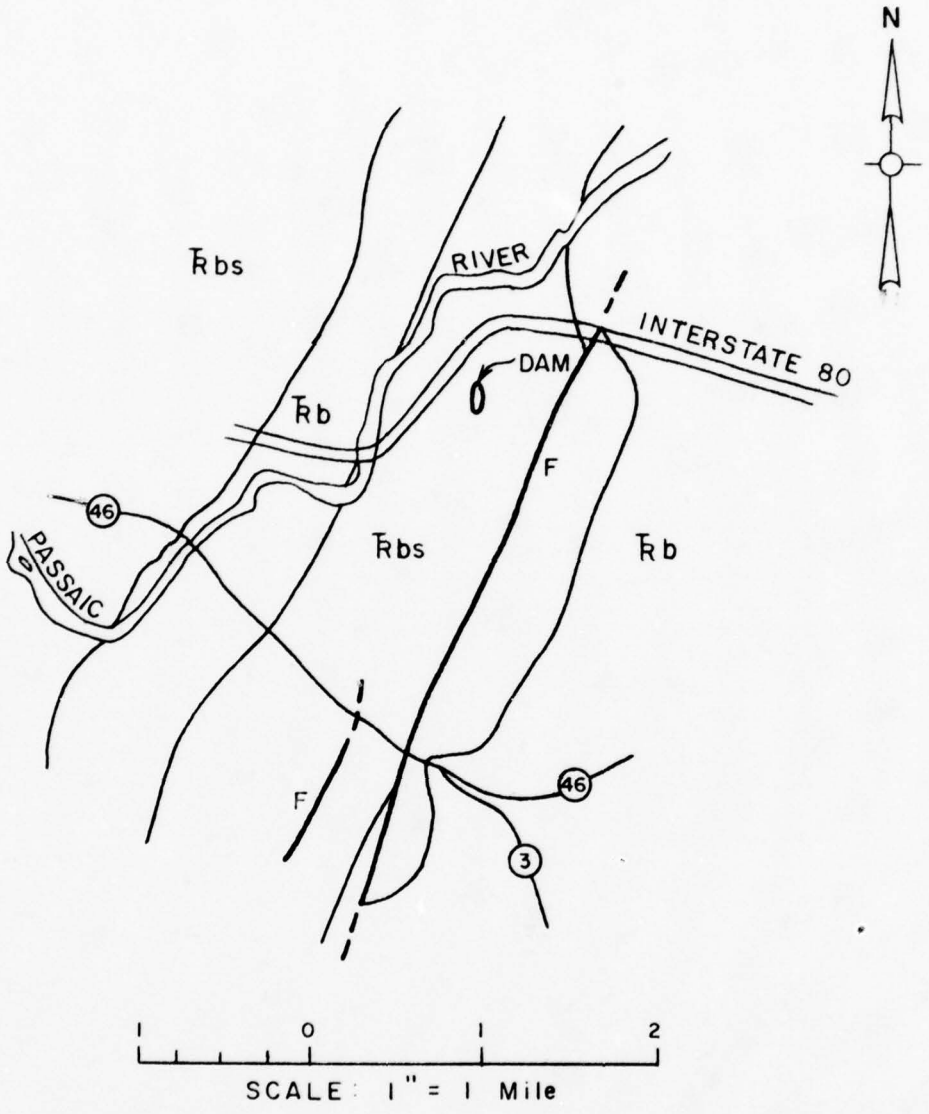
The deteriorated facing of the dam should be repaired.

PLATES



VICINITY MAP

PLATE 1

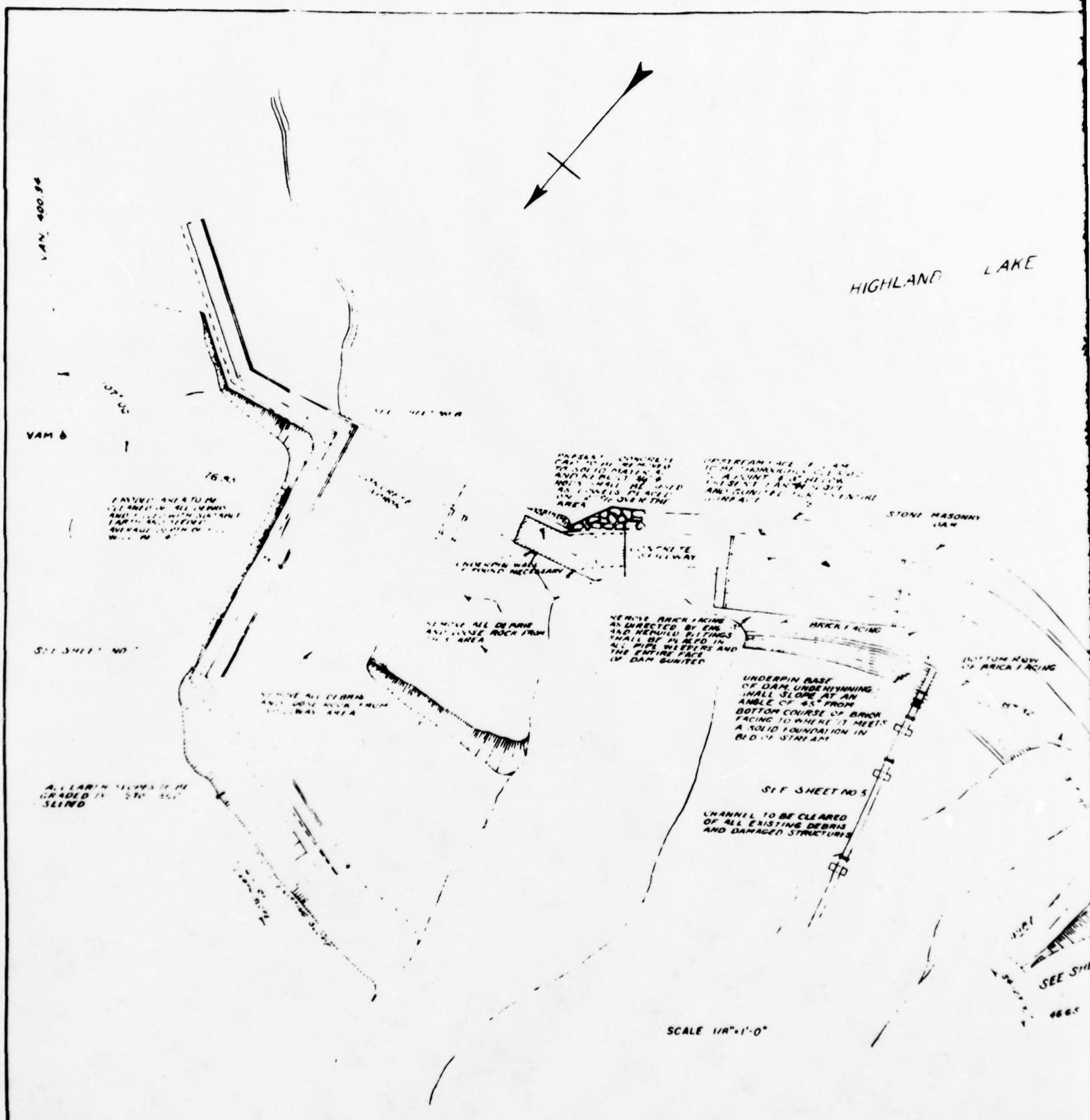


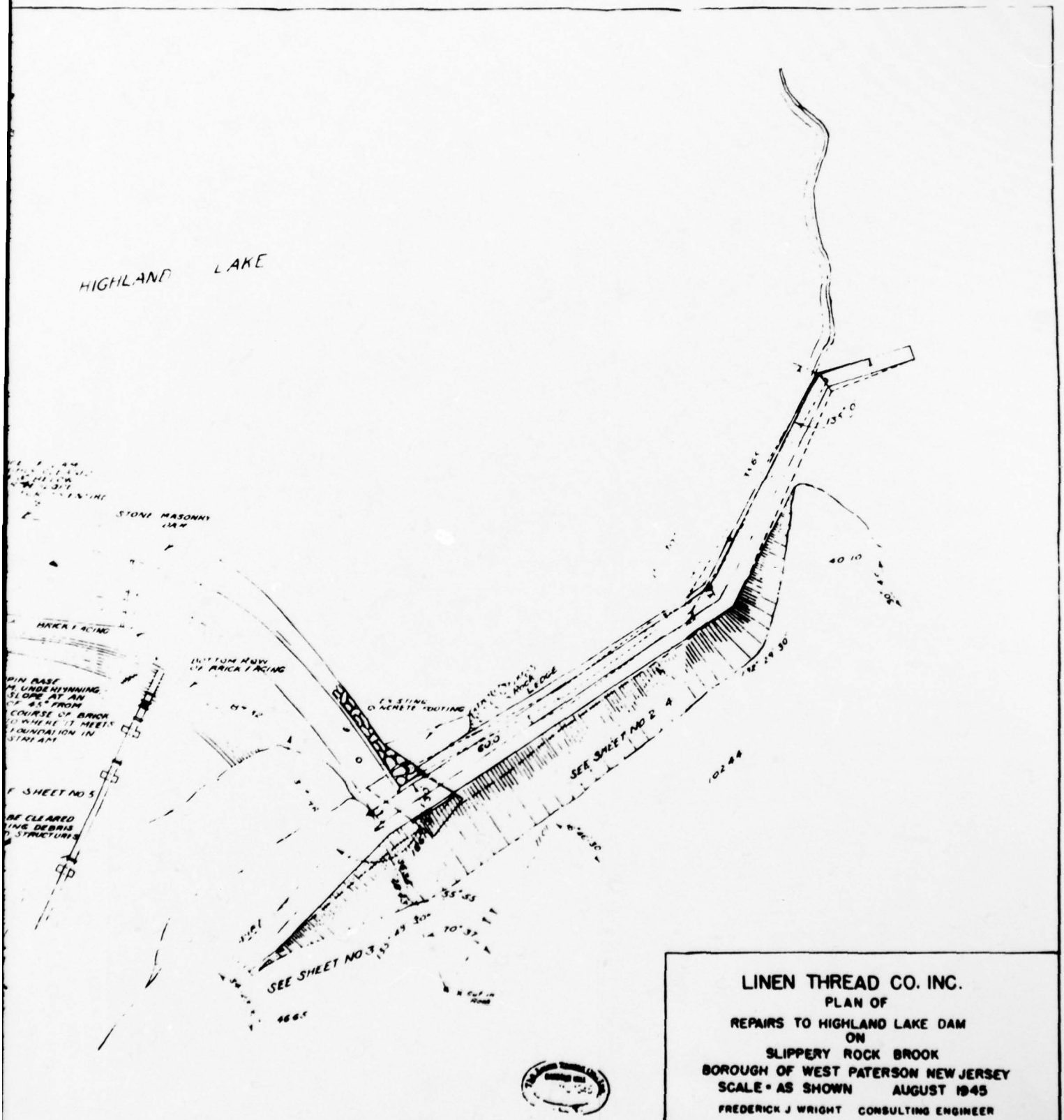
LEGEND

TRb	BRUNSWICK FORMATION RED SANDSTONE WITH INTERBEDS OF SOFT, RED SHALE
TRbs	BASALT
F	FAULT

GEOLOGIC MAP
HIGHLAND LAKE DAM

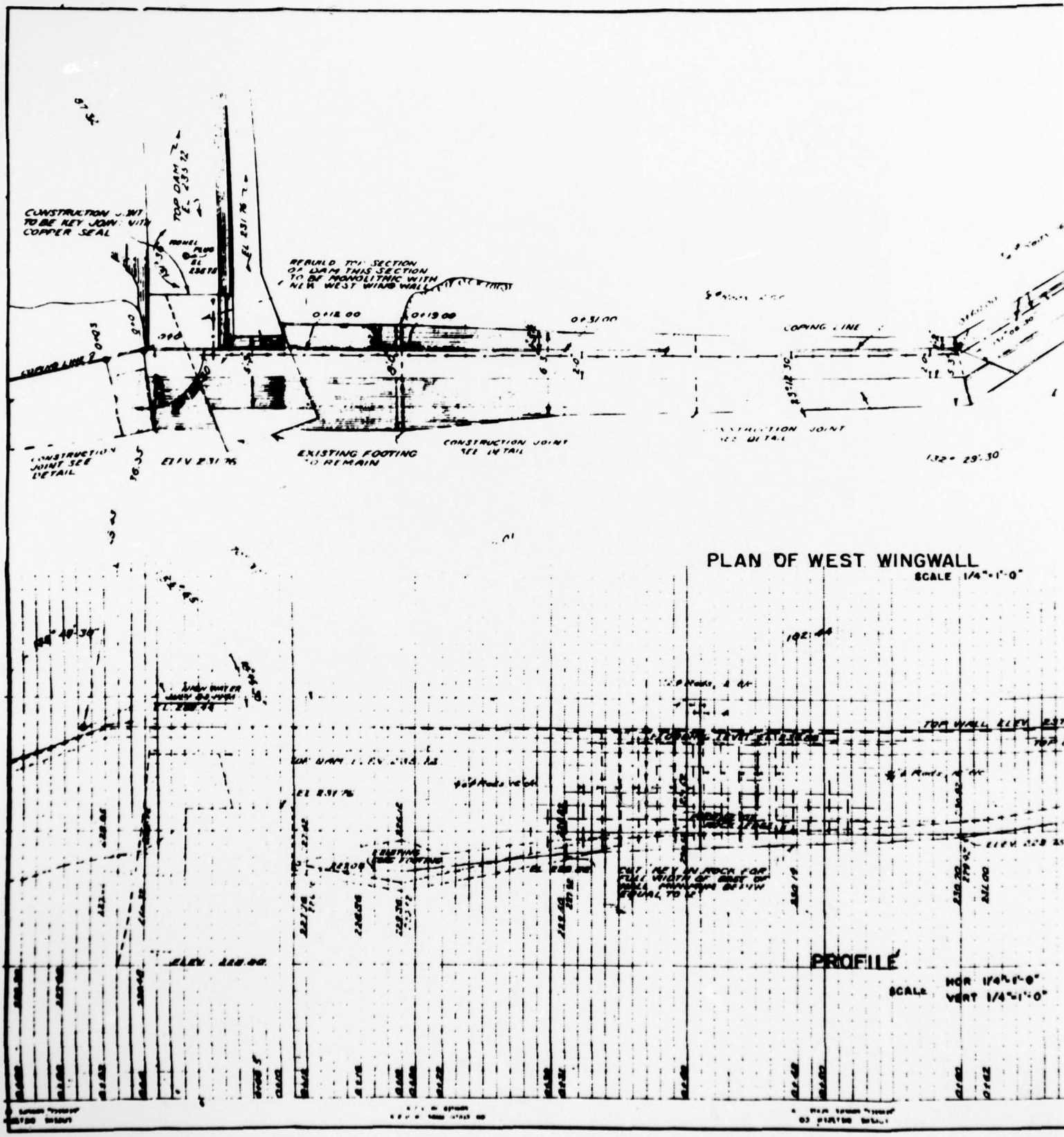
PLATE 2


HIGHLAND LAKE
STONE MASONRY DAM
BRICK FACING
UNDERPIN BASE OF DAM, UNDERMINING SHALL SLOPE AT AN ANGLE OF 45° FROM BOTTOM COURSE OF BRICK FACING TO WHERE IT MEETS A SOLID FOUNDATION IN BED OF STREAM
SEE SHEET NO 5
CHANNEL TO BE CLEARED OF ALL EXISTING DEBRIS AND DAMAGED STRUCTURES
SCALE 1/8"=1'-0"

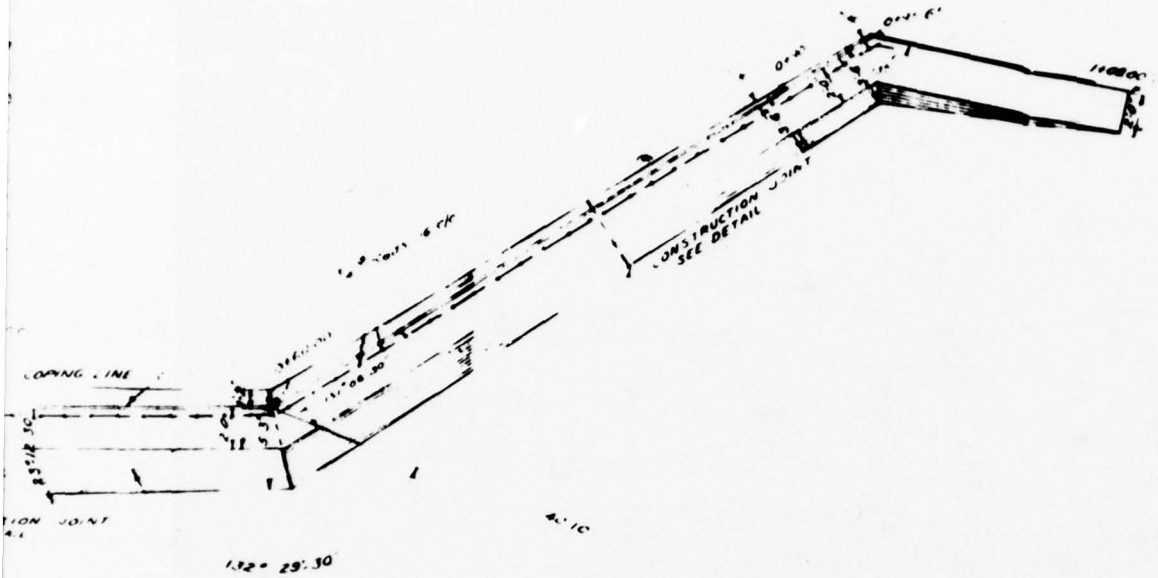


LINEN THREAD CO. INC.
PLAN OF
REPAIRS TO HIGHLAND LAKE DAM
ON
SLIPPERY ROCK BROOK
BOROUGH OF WEST PATERSON NEW JERSEY
SCALE - AS SHOWN AUGUST 1945
FREDERICK J WRIGHT CONSULTING ENGINEER

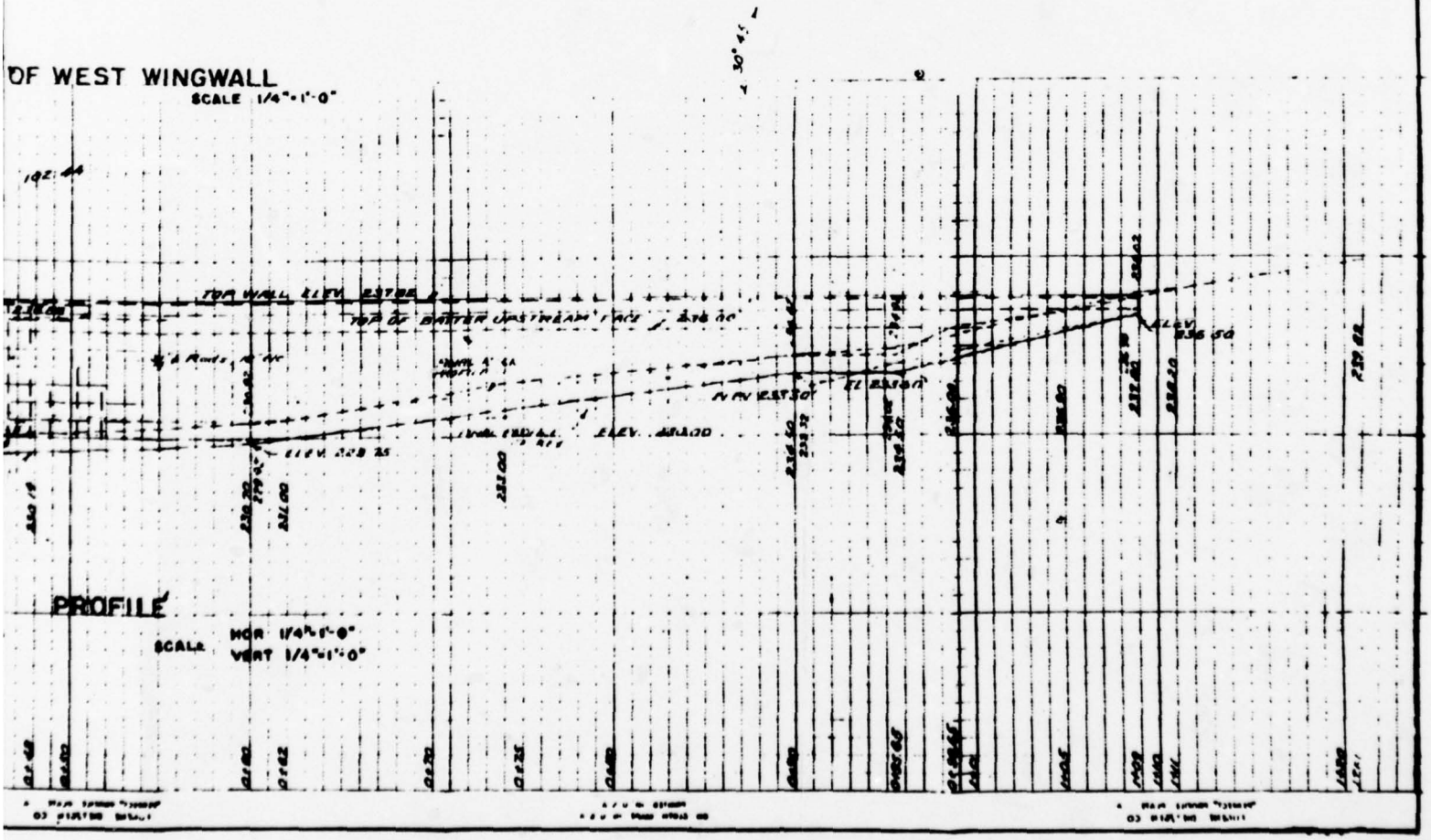
PLATE 3


CONSTRUCTION JOINT TO BE KEY JOINT WITH COPPER SEAL
TOP DAM EL 233.12
EL 231.75
REBUILD THIS SECTION OF DAM THIS SECTION TO BE MONOLITHIC WITH NEW WEST WING WALL
0+12.00
0+19.00
0+31.00
COPING LINE
ANCHOR LINE
CONSTRUCTION JOINT SEE DETAIL
EL 231.75
EXISTING FOOTING TO REMAIN
CONSTRUCTION JOINT SEE DETAIL
CONSTRUCTION JOINT SEE DETAIL
132+ 29.30
PLAN OF WEST WINGWALL
SCALE 1/4"=1'-0"
EL 220.00
PROFILE
SCALE HOR 1/4"=1'-0"
VERT 1/4"=1'-0"

LINEN THREAD CO INC
HIGHLAND LAKE DAM
SHEET NO 2



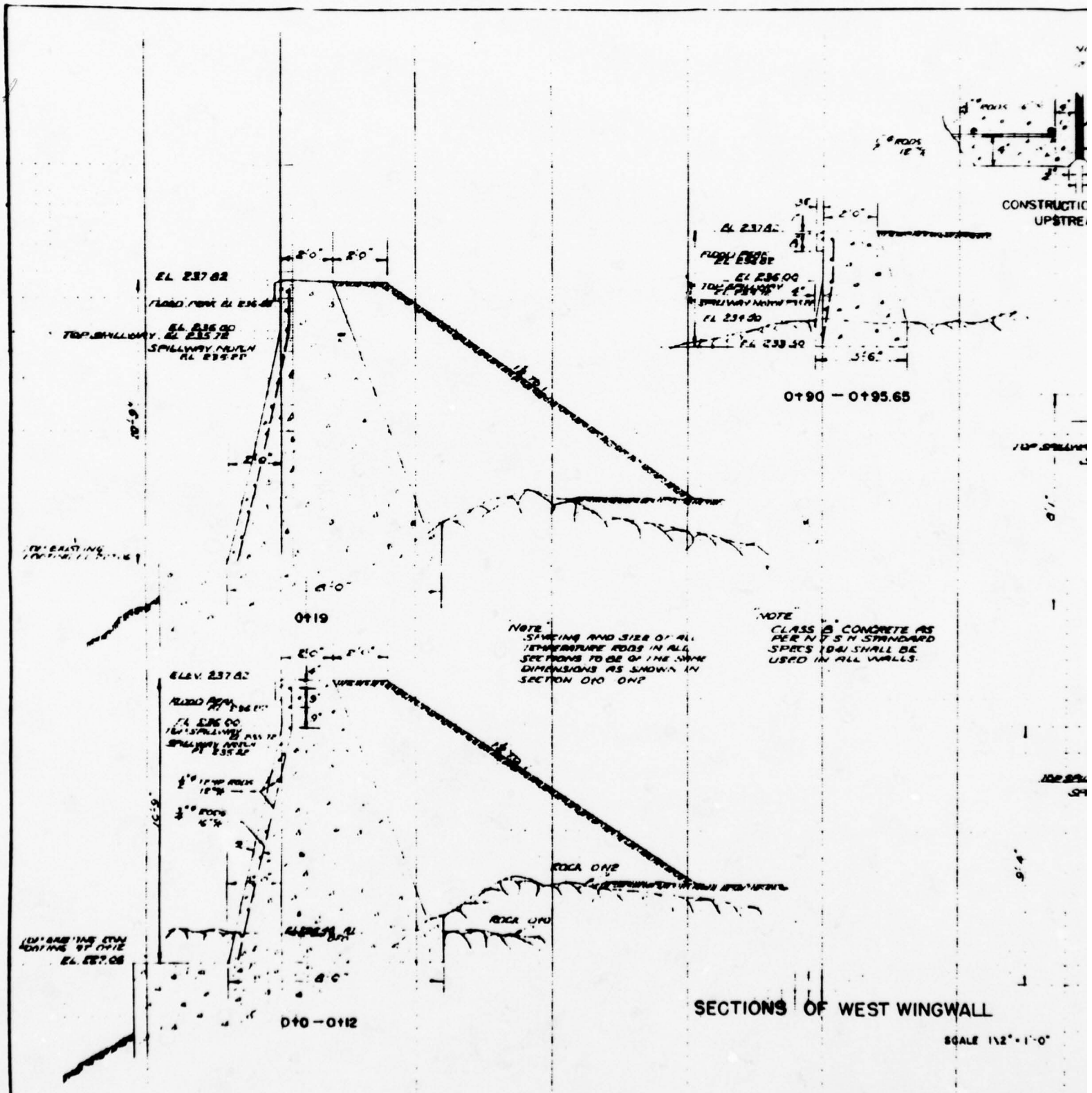
OF WEST WINGWALL
SCALE 1/4"=1'-0"



PROFILE
SCALE HOR 1/4"=1'-0"
VERT 1/4"=1'-0"

PLATE 4

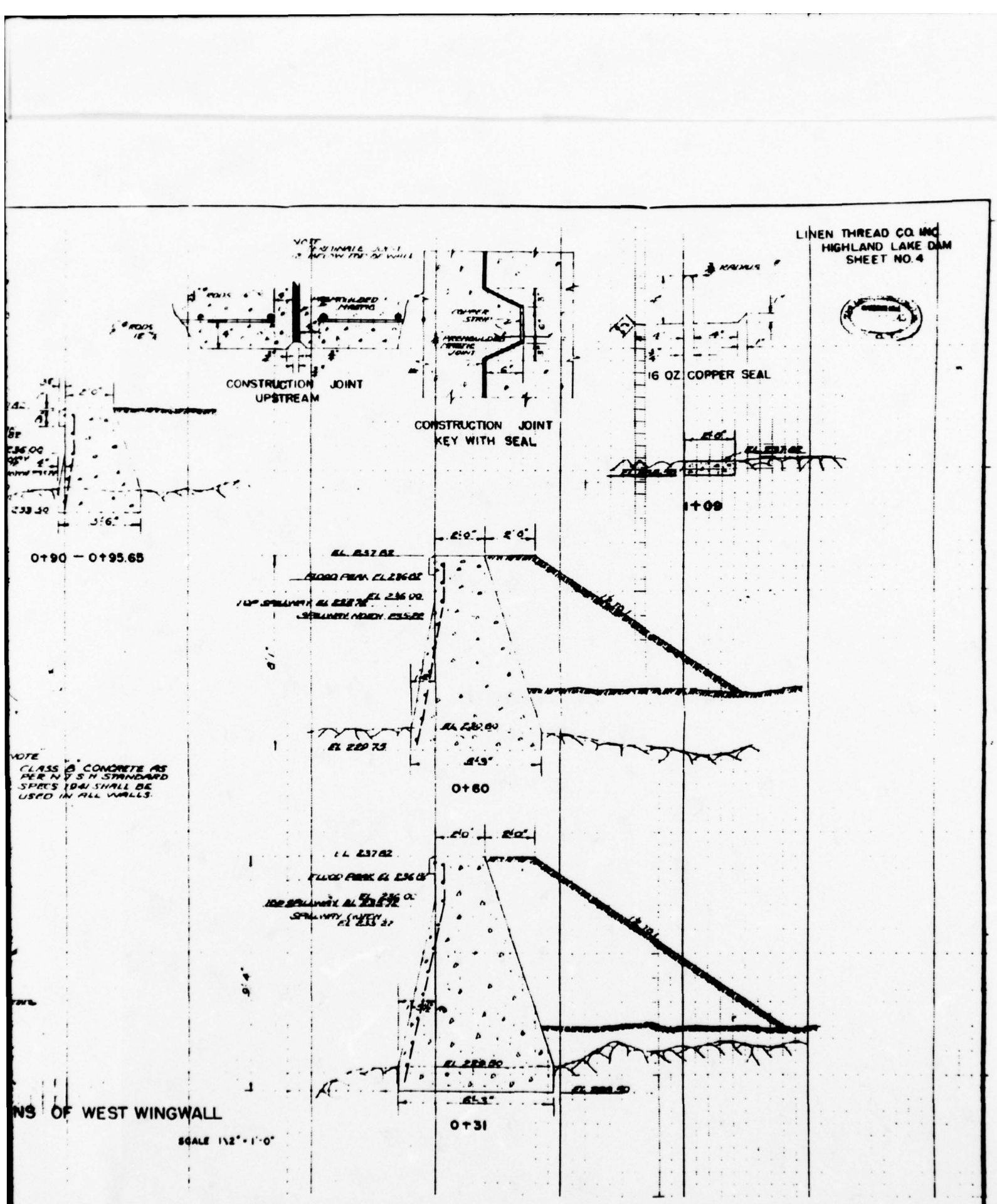
2



SECTIONS OF WEST WINGWALL

SCALE 1\2" = 1'-0"

LINEN THREAD CO. INC.
HIGHLAND LAKE DAM
SHEET NO. 4



NS OF WEST WINGWALL

SCALE 1\2" = 1'-0"

PLATE 5

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION MAINTENANCE DATA

CHECK LIST

Visual Inspection
Phase I

Name Dam Highland Lake County Passaic State New Jersey Coordinators _____

Date(s) Inspection June 29, 1978 Weather Clear-Hot Temperature 85°F

Pool Elevation at Time of Inspection No gage M.S.L. Tailwater at Time of Inspection None M.S.L.
W.S. at spillway crest.

Inspection Personnel:

(June 29, 1978)	(June 29, 1978)	(July 6, 1978)
Joe Siriani	William Flynn	Yin Au-Yeung
Henry King		Lynn Brown
David Kerkes		

Robert B. Campbell Recorder

Owner Representative:
(June 29, 1978)
Tom Dinand, Maintenance Superintendent
Bank of New Jersey

CONCRETE/MASONRY DAMS

Highland Lake

Type - Curved Rock Masonry w/Brick Facing and then Gunite Coating

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	Considerable leakage from drain holes in gunite. Seepage overflowing out of outlet vault. Some seepage at foundation contact in lower third of left abutment and lower half of right abutment.	Install toe drains through brick to drain behind facing. Install collector and measuring device to measure seepage. Monitor seepage monthly to detect changes in quantity or quality of water.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Rock outcrops right and left abutment. Serious loosening of brick at abutment contact on right abutment just below mid-height of dam. Void in brick is 10 inches deep and extends 4 feet horizontally from abutment and 3 feet vertically.	Loose gunite coating should be removed and brick and gunite facings should be repaired.
DRAINS	1" diameter holes and pipes in gunnite coating on about 4 foot horizontal spacing staggered on lines spaced about 2′ vertically. Many drain holes flowing trickles of water.	See note above on toe drains.
WATER PASSAGES	See Spillways and Outlet Works.	
FOUNDATION	Dam founded directly on massive bedrock. Rock shows extensive fracturing. Large fractures on left abutment that may extend under dam.	

CONCRETE/MASONRY DAMS

Highland Lake

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Considerable spalling of gunite coating, especially near right abutment. Gunite coating varies from 2 to more than 6 inches. Severe spalling at top of concrete cap.	Loose gunite should be removed and repaired. See note previous page.
STRUCTURAL CRACKING	Structure hidden by gunite. Crack of no significance is evident at bottom of concrete cap slab.	
VERTICAL AND HORIZONTAL ALIGNMENT	No evidence of movement of structure can be found.	
MONOLITH JOINTS	None visible.	
CONSTRUCTION JOINTS	None visible.	

EMBANKMENT

Type - None

Highland Lake

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	N.A.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	N.A.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	N.A.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	N.A.	
RIPRAP FAILURES	N.A.	

EMBANKMENT

Highland Lake

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	N.A.	
ANY NOTICEABLE SEEPAGE	N.A.	
STAFF AND GAGE RECORDER	N.A.	
DRAINS	N.A.	

OUTLET WORKS

Highland Lake

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Outlet works abandoned. Was 12" C.I. pipe outlet with valve in concrete vault. Leakage or seepage is flowing from vault opening. Concrete in vault is sound.	Outlet works should be repaired and put back into use. Small drain hole may need to be installed to allow seepage to drain from vault.
INTAKE STRUCTURE	Submerged and not visible. Cannot be inspected.	
OUTLET STRUCTURE	Outlet vault is filled to within one foot of top with 1/2-3/4" pebbles.	Pebbles should be cleaned out of vault and a cover and lock should be installed on vault.
OUTLET CHANNEL	None.	
EMERGENCY GATE	None.	

UNGATED SPILLWAY

#2 - Service Spillway-Right Abutment

Highland Lake

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Broad crest spillway 5 feet long. Floor moderately spalled.	Spalled concrete should be repaired whenever depth exceeds 3-4 inches.
APPROACH CHANNEL	None - Water depth is very shallow in front of spillway.	
DISCHARGE CHANNEL	Nearly vertical natural rock down to paved apron between dam and headwall. No obstructions.	
BRIDGE AND PIERS	None.	

UNGATED SPILLWAY

#2 - Service Spillway-Right Abutment

Highland Lake

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Broad crest spillway 5 feet wide. Floor moderately spalled.	Spalled concrete should be repaired whenever depth exceeds 3-4 inches.
APPROACH CHANNEL	None - Water depth is very shallow in front of spillway.	
DISCHARGE CHANNEL	Nearly vertical natural rock down to paved apron between dam and headwall. No obstructions.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

(None)

Highland Lake

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N.A.	
APPROACH CHANNEL	N.A.	
DISCHARGE CHANNEL	N.A.	
BRIDGE AND PIERS	N.A.	
GATES AND OPERATION EQUIPMENT	N.A.	

INSTRUMENTATION

Highland Lake

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

Highland Lake

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Varies. 60% is nearly flat to gently sloping with grassed lawn coverage for park. 40% steeply sloping rocky bank to about 20 feet height. All slopes appear stable.	
SEDIMENTATION	Extent of existing sedimention unknown. Upstream lagoon constructed during building of bank will effectively stop further sedimention.	
Shoreline Structures	No dwellings or structures are on shorelines. Bank of New Jersey owns property around lake for many hundreds of feet from shoreline.	
Use	Aesthetic - Scenic only. Area east of lake has been developed into a park.	
Operation	None - Water level is not regulated. Nature let to take its course.	

DOWNSTREAM CHANNEL

Highland Lake

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Watercourse consists of a 272 feet long by 6 feet diameter concrete pipe culvert under bank parking lot, then concrete lined rectangular channel to 6′ diameter culvert under Highway 80.	
SLOPES	Not Applicable.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	No dwellings or buildings exist between the dam and Highway 80.	

CHECK LIST
ENGINEERING DATA

DESIGN, CONSTRUCTION, OPERATION

Highland Lake Dam

ITEM	REMARKS
PLAN OF DAM	None available.
REGIONAL VICINITY MAP	Available.
CONSTRUCTION HISTORY	None available.
TYPICAL SECTIONS OF DAM	None available.
HYDROLOGIC/HYDRAULIC DATA	None available.
OUTLETS - PLAN	)
- DETAILS	) None Available.
- CONSTRAINTS	)
- DISCHARGE RATINGS	)
RAINFALL/RESERVOIR RECORDS	None Available.

CHECK LIST
ENGINEERING DATA

DESIGN, CONSTRUCTION, OPERATION
(Continued)

Highland Lake Dam

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	The dam was surveyed and drawings of repairs to the toe of the dam and to the abutments were prepared in 1945 and are available from New Jersey Department of Environmental Protection.
BORROW SOURCES	Unknown.
SPILLWAY - PLAN - SECTIONS - DETAILS	None available.

CHECK LIST
ENGINEERING DATA

DESIGN, CONSTRUCTION, OPERATION
(Continued)

Highland Lake Dam

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	None available.
MONITORING SYSTEMS	None available.
MODIFICATIONS	Repairs and modifications including extending the spillway, gunniting both faces of the masonry dam, installing toe underpinning, and rebuilding abutment walls was done in 1945.
HIGH POOL RECORDS	None available.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available.
PRIOR ACCIDENTS OR FAILURE OF DAM - DESCRIPTION - REPORTS	A severe storm in 1945 caused an upstream dike to fail producing a flood wave that overtopped and washed away the topsoil on both abutments.
MAINTENANCE, OPERATION RECORDS	None available.

APPENDIX B

PHOTOGRAPHS

(All photos were taken on June 29, 1978.)

Photo 1 - View along crest of dam from left abutment showing main spillway and service spillway on right abutment.

Photo 2 - View of dam and left abutment from upstream right shoreline.

Photo 3 - View of dam and bank parking lot below dam.

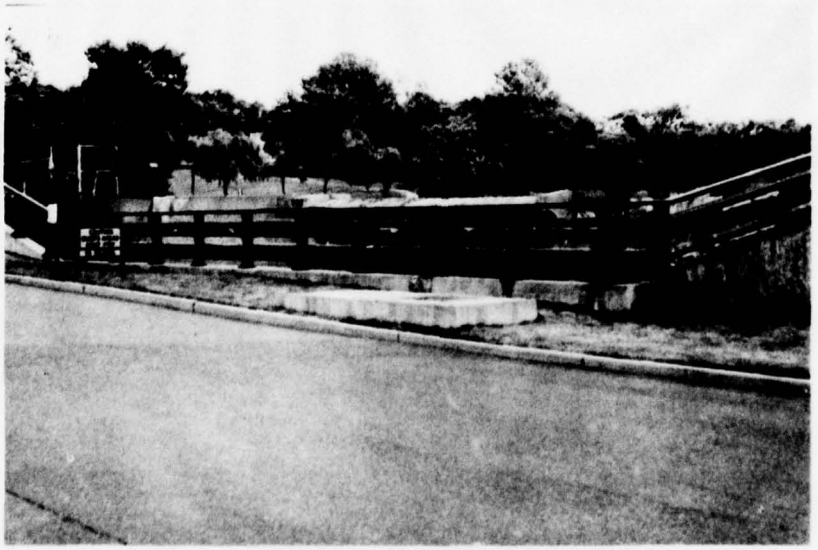


Photo 4 - View of dam from bank parking lot. Dam is partially hidden by guard railing on parking lot retaining wall.

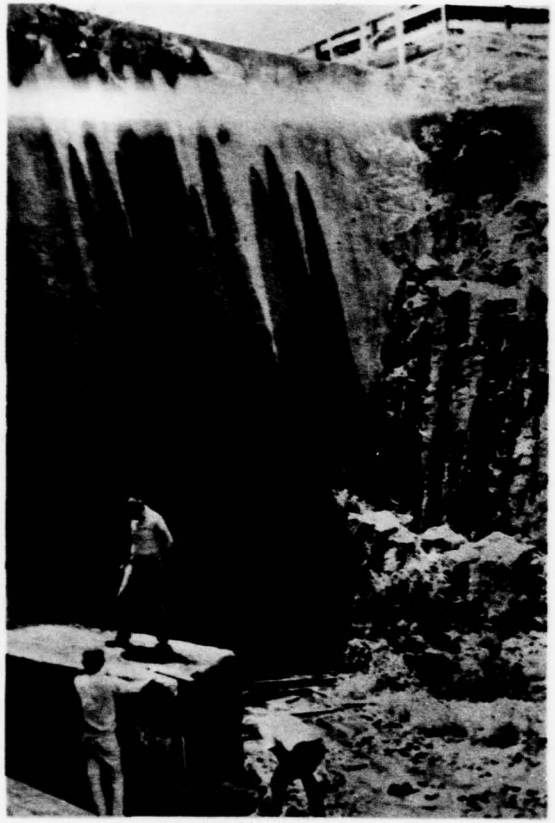


Photo 5 - View showing dam, left abutment rock and abandoned outlet pipe and concrete vault.

Photo 6 - View of joint in rock located in left abutment of dam.

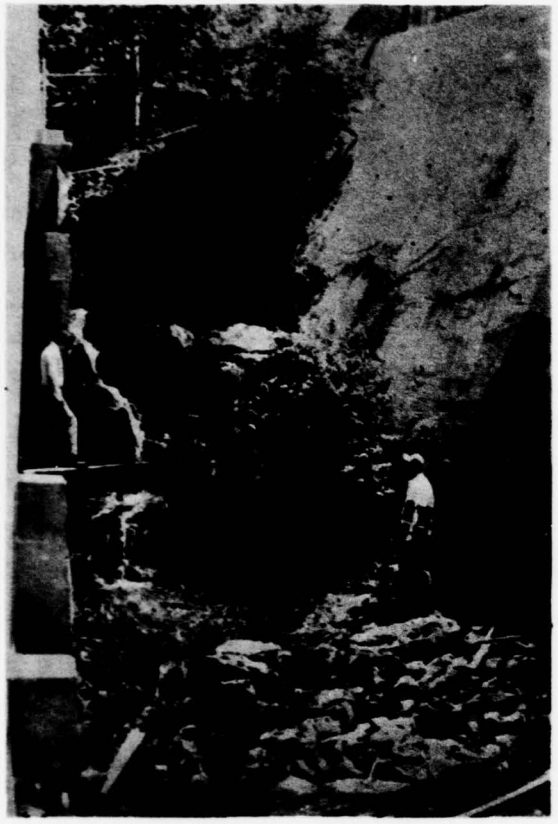


Photo 7 - View showing dam, right abutment rock, downstream parking lot retaining wall and service spillway discharge down rock abutment.

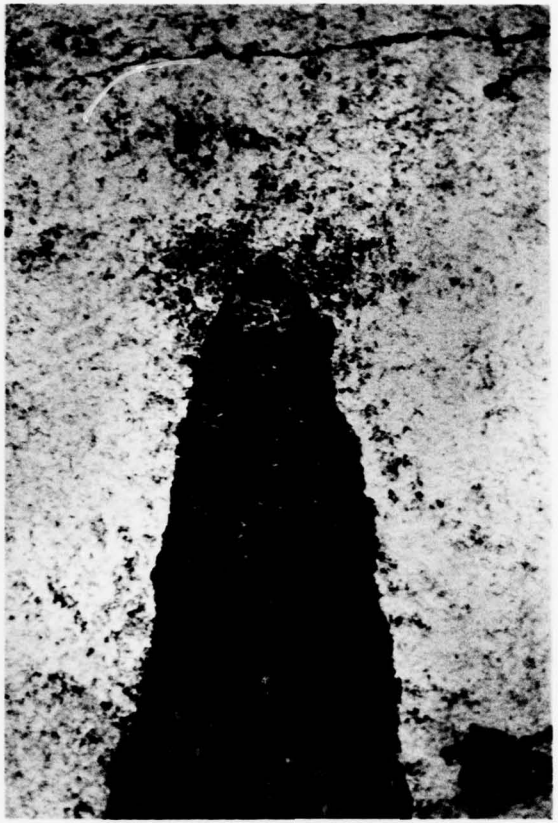


Photo 8 - Drain hole in gunite facing on downstream face of dam.

Photo 9 - Drain holes and exposed wire mesh under spalled gunite.

Photo 10 - Exposed brick facing under spalled and displaced gunite facing at right abutment.

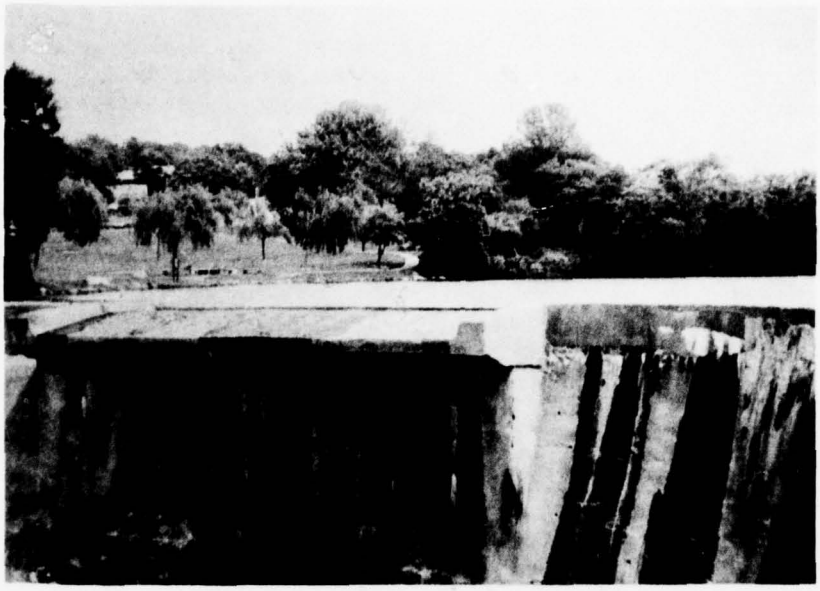


Photo 11 - Main spillway and right shoreline.

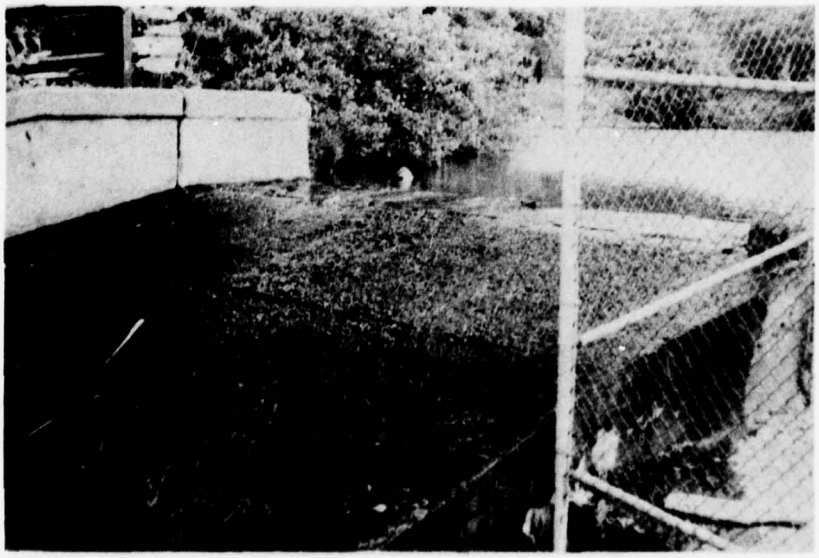


Photo 12 - Service spillway from downstream.

Photo 13 - View of dam, bottom slab under main spillway, retaining wall and discharge culvert under parking lot.

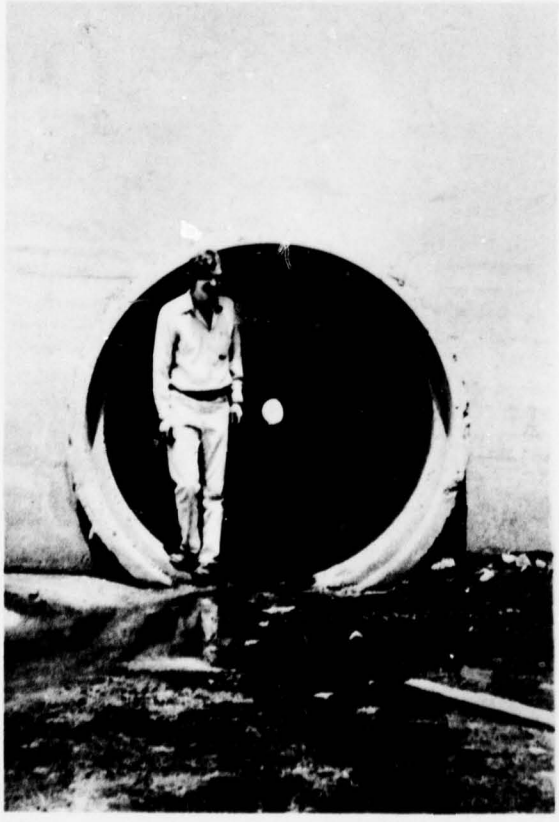


Photo 14 - Inlet and 6 ft. diameter concrete pipe discharge culvert.

Photo 15 - Outlet structure for parking lot culvert.

Photo 16 - Inlet to 6 ft. diameter culvert under Highway 80.

Photo 17 - View of Highland Lake from right abutment showing barrage built from bank excavation and forming small upper impoundment.

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST

HYDROLOGIC AND HYDRAULIC DATA

ENGINEERING DATA

Name of Dam: Highland Lake Dam

Drainage Area: 0.76 square miles

Elevation Top Normal Pool (Storage Capacity): 235.22 (49 AF)

Elevation Top Flood Control Pool (Storage Capacity): Not applicable

Elevation Maximum Design Pool: 236.24

Elevation Top of Dam: 237.82

SPILLWAY CREST:

a. Elevation: 235.22

b. Type: Overflow

c. Width: 4 feet (right end spillway); 10 feet (spillway at the mid-section)

d. Length: 44 feet (total notch length)

e. Location Spillover: One at right end and one at mid-section of dam

f. Number and Type of Gates: None

OUTLET WORKS:

a. Type: 12-inch cast iron pipe (inoperable)

b. Location: Left side of the dam

c. Entrance Inverts: Not applicable

d. Exit Inverts: Not applicable

e. Emergency Draindown Facilities: Not applicable

HYDROMETEOROLOGICAL GAGES: (None)

a. Type:

b. Location:

c. Records:

MAXIMUM NON-DAMAGING DISCHARGE: 800 cfs (Estimated) This is the maximum discharge that will not cause damage downstream from the dam.

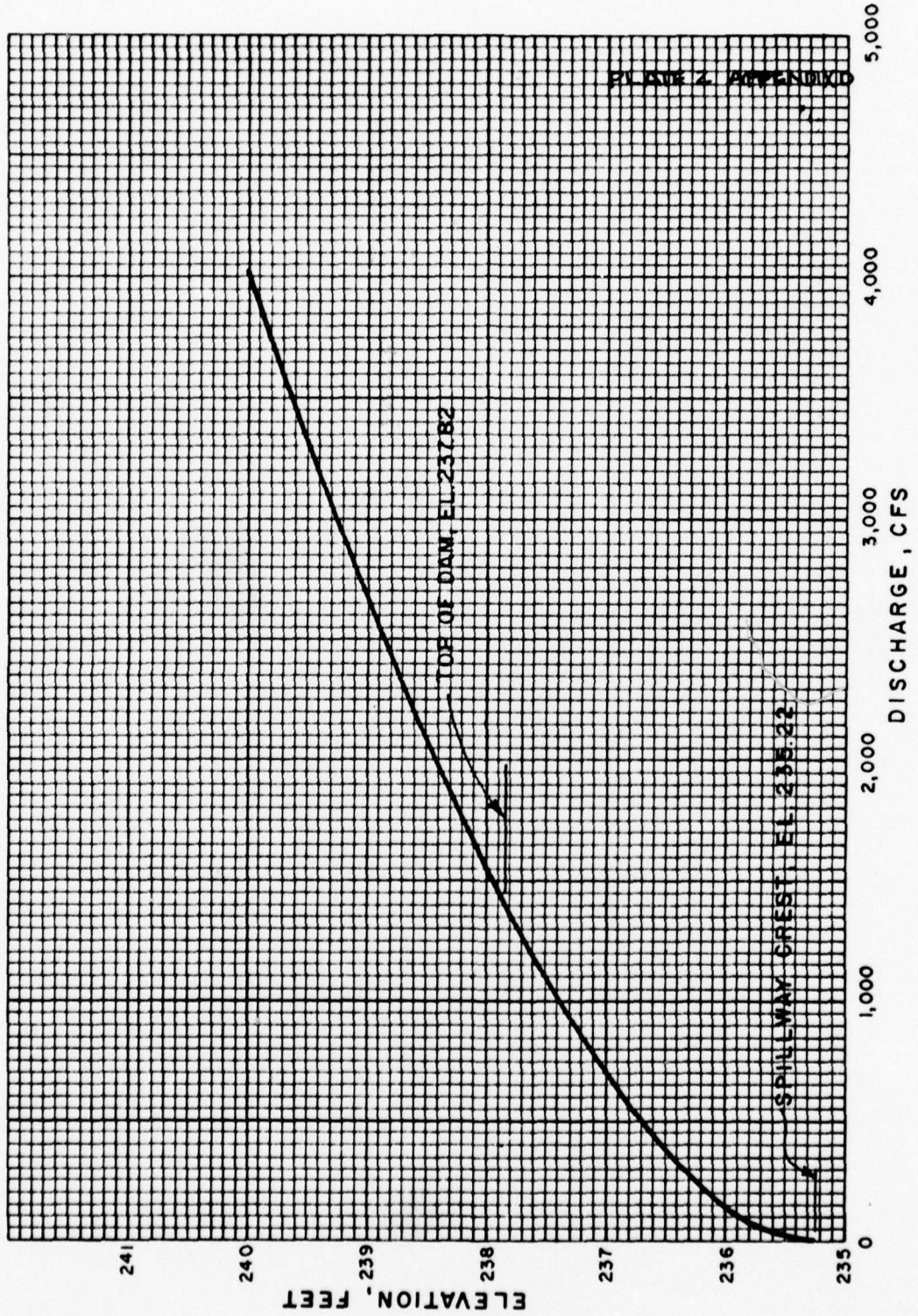
APPENDIX D

HYDROLOGIC COMPUTATIONS

PLATE 1 APPENDIX D

HIGHLAND LAKE DAM
DRAINAGE BASIN

PLATE 2. APPENDIX



HIGHLAND LAKE DAM
SPILLWAY & OVERTOP RATING CURVE

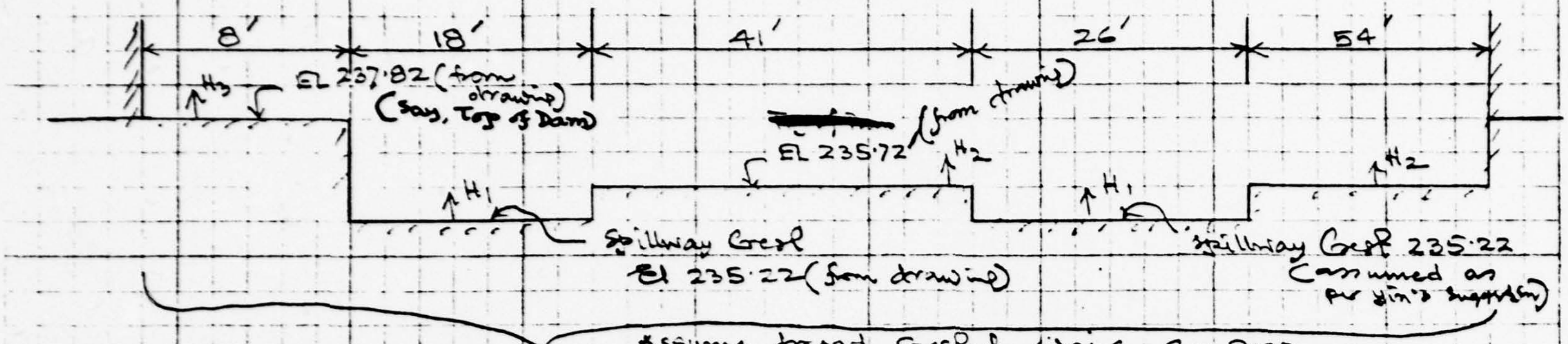
ECI-4 **ENGINEERING CONSULTANTS, INC.**

NEW JERSEY (STATE) DAM SAFETY INSPECTION — SHEET NO. 1 OF

HIGHLAND LAKE DAM — JOB NO. 1212-001

SPILLWAY & OVERTOP RATING CURVE — BY MAS — DATE 7-14

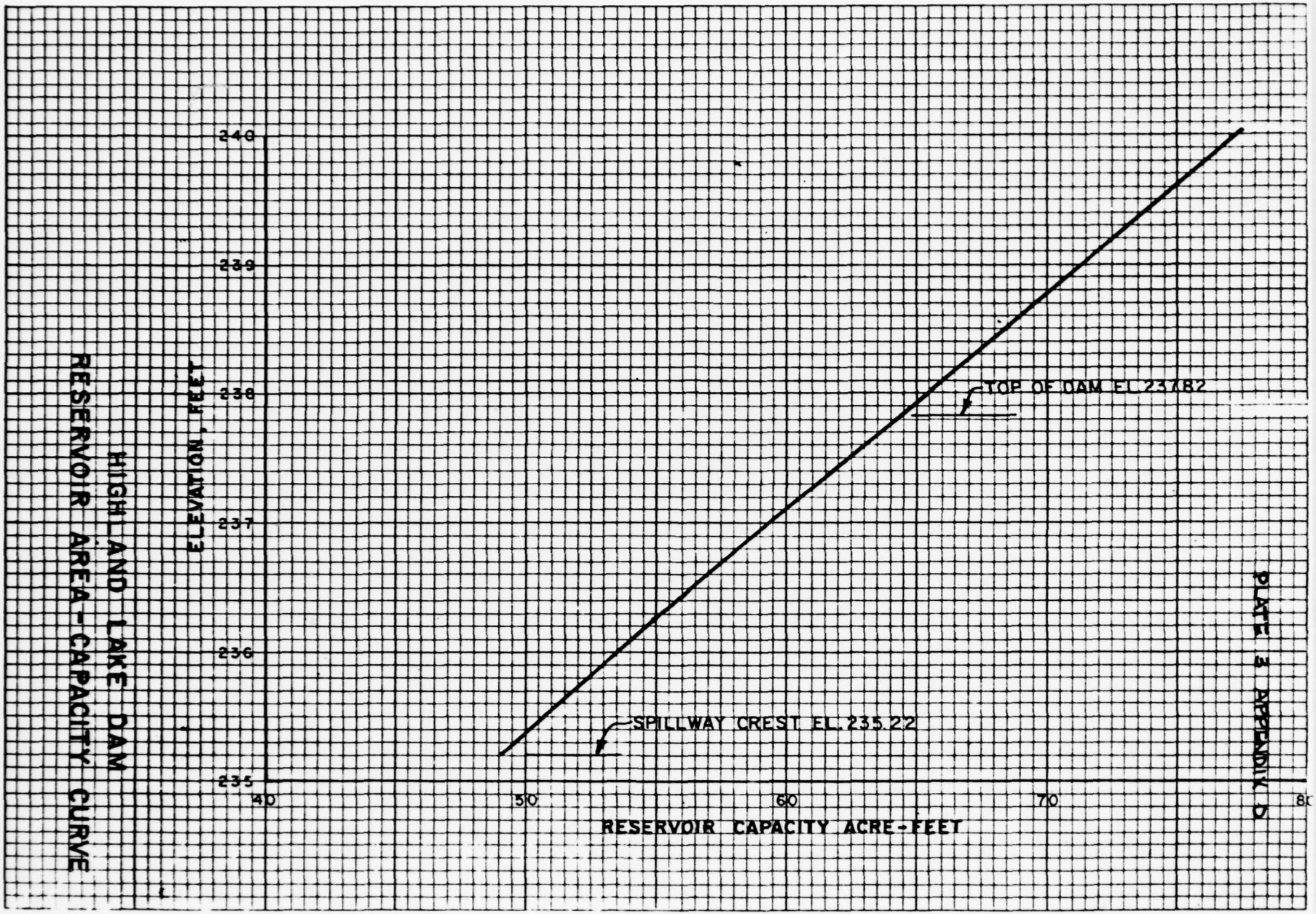
$L_1 = 18+26 = 44'$, $L_2 = 41+54 = 95'$, $L_3 = 8'$



Assume broad Crested Weir, C = 3.03

$C_1 = C_2 = C_3 = C = 3.03$

ELEV. feet	Head on Spillway Crest ft	H_1	H_2	H_3	L_1	L_2	L_3	C_1	C_2	C_3	
235.22	0	0	-								0
235.72	0.5	0.5	0		44			3.03			47
236.72	1.5	1.5	1.0		44	95		3.03	3.03		533
237.82	2.6	2.6	2.1	0	44	95		3.03	3.03		1435
238.82	3.6	3.6	3.1	1.0	44	95	8	3.03	3.03	3.03	2506
240	4.78	4.78	4.28	2.18	44	95	8	3.03	3.03	3.03	4020


HIGHLAND LAKE DAM
RESERVOIR AREA-CAPACITY CURVE
ELEVATION, FEET
240
239
238
237
236
235
40
50
60
70
80
RESERVOIR CAPACITY ACRE-FEET
TOP OF DAM EL. 237.82
SPILLWAY CREST EL. 235.22
PLATE 1 APPENDIX D

ECI-4 ENGINEERING CONSULTANTS, INC.

NEW JERSEY (STATE) DAM SAFETY INSPECTION — SHEET NO. 1 OF
HIGHLAND LAKE DAM — JOB NO. 1212-001
RESERVOIR AREA-CAPACITY DATA — BY MAS DATE 7-17-

HIGHLAND LAKE DAM

RESERVOIR AREA-CAPACITY DATA

Maximum Storage = 55 Acre-feet,

Normal Storage = 49 A-F,

Reservoir Surface Area = 5.73 Acres (from 7½ USGS topo map) El = 285.22 (assumed to be at Spillway crest).

Elev. Ft.	Reservoir Surface Area Acres	Reservoir Volume AC-FT	Remarks
235.22	5.73	49	The normal volume of 49 acre-ft is assumed to be at Spillway (or) El 235.22
236.24	6±	55	The elevation of maximum storage of 55 AC-FT is obtained by assuming a reservoir surface area of 6± acres.
237.82	6±	64.5	The volume figures are extended by assuming the same area of 6± acres
240	6±	77.6	

ECI-4 ENGINEERING CONSULTANTS, INC.

NEW JERSEY (STATE) DAM SAFETY INSPECTION — SHEET NO. 1 OF 4
HIGHLAND LAKE DAM #5 — JOB NO. 1212-001-
UNIT HYDROGRAPH — BY KLB DATE 7-11-

UNIT HYDROGRAPH – HIGHLAND LAKE DAM

a) DRAINAGE AREA = 0.76 SQ. MI.

b) L = 0.91 MILES (FROM PAGE 2)

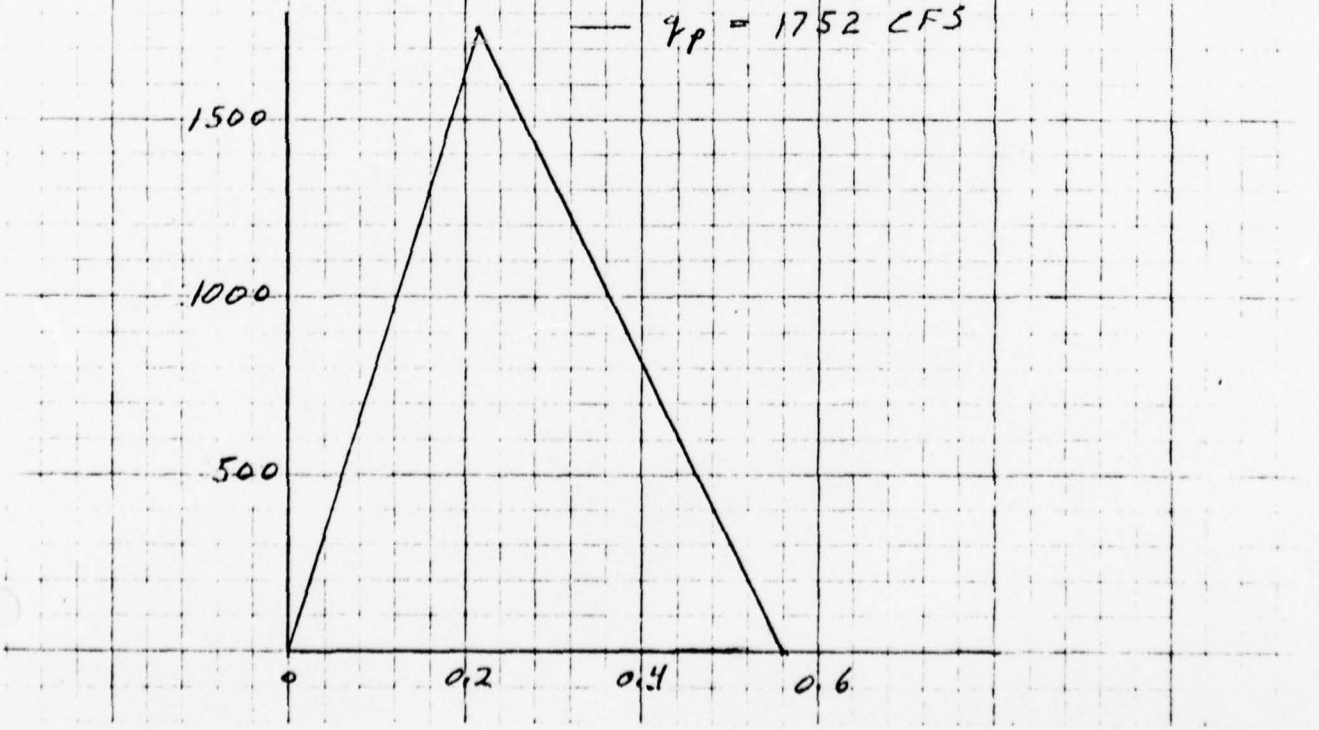
c) T_c = 0.27 HR (FROM PAGE 2)

d) ASSUME D = 0.10 HR < $\frac{T_c}{2}$

e) $T_p = \frac{D}{2} + 0.6 \times T_c = 0.05 + 0.6 \times 0.27$
$= 0.21$ HR

f) $T_b = 2.67 \times T_p = 0.56$ HR

g) $q_{p\,CFS} = \frac{484\ A\,(SQ.\,MI)}{T_p\,(HR)} = \frac{484 \times 0.76}{0.21} = 1752$ CFS



ENGINEERING CONSULTANTS, INC.

NEW JERSEY (STATE) DAM SAFETY INSPECTION — SHEET NO. 2 OF
HIGHLAND LAKE DAM, #5 — JOB NO. 1212-001
DETERMINE BASIN PARAMETERS — BY KLB DATE

DETERMINE LENGTH OF STREAM

FROM USGS QUAD SHEETS

$$L = 2.4'' \times \frac{24000}{12 \times 5280} = 0.91 \text{ MILES} = 4800 \text{ FT}$$

DETERMINE BASIN SLOPE

$$\Delta H = 495 - 235 = 260 \text{ FT.}$$

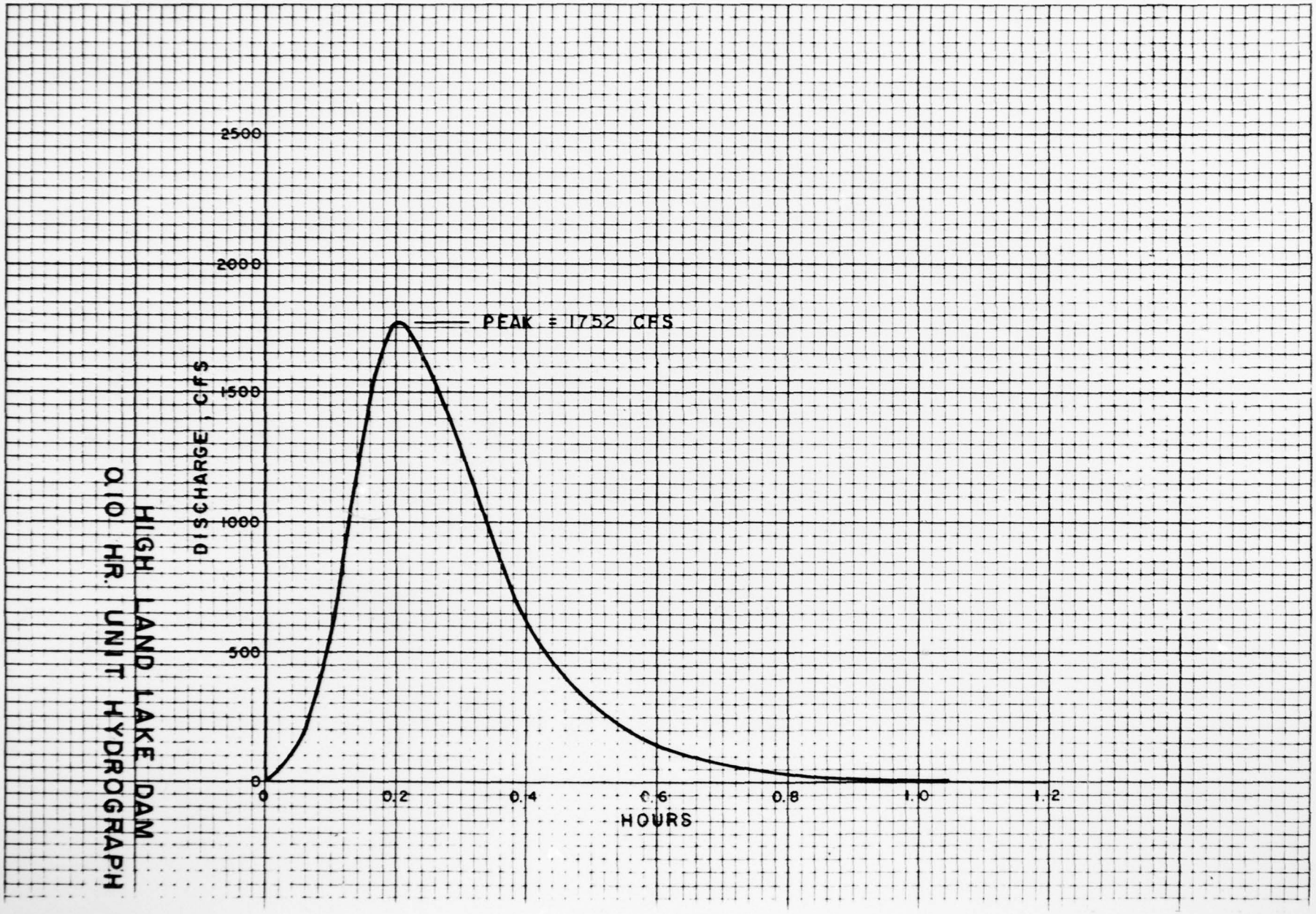
DETERMINE TIME OF CONCENTRATION

$$T_C = \left(\frac{11.9\,L^3}{\Delta H}\right)^{0.385} = \left(\frac{11.9 \times 0.91^3}{260}\right)^{0.385}$$

$$= 0.27 \text{ HR.}$$

h) CURVILINEAR HYDROGRAPH

TIME RATIO T/T_p	DISCHARGE RATIO q/q_p	UNIT GRAPH TIME T (HR)	UNIT GRAPH DISCHARGE q (CFS)
0	0	0	0
0.1	0.015	0.021	26
0.2	0.075	0.042	131
0.3	0.16	0.063	280
0.4	0.28	0.084	491
0.5	0.43	0.105	753
0.6	0.60	0.126	1051
0.7	0.77	0.147	1349
0.8	0.89	0.168	1559
0.9	0.97	0.189	1699
1.0	1.00	0.210	1752
1.1	0.98	0.23	1717
1.2	0.92	0.25	1612
1.3	0.84	0.27	1472
1.4	0.75	0.29	1314
1.5	0.66	0.32	1156
1.6	0.56	0.34	981
1.8	0.42	0.38	736
2.0	0.32	0.42	561
2.2	0.24	0.46	420
2.4	0.18	0.50	315
2.6	0.13	0.55	228
2.8	0.098	0.59	172
3.0	0.075	0.63	131
3.5	0.036	0.74	63
4.0	0.018	0.84	32
4.5	0.009	0.95	16
5.0	0.004	1.05	7


HIGH LAND LAKE DAM
Q10 HR. UNIT HYDROGRAPH
DISCHARGE C.F.S.
2500
2000
1500
1000
500
0
PEAK = 1752 CFS
0
0.2
0.4
0.6
0.8
1.0
1.2
HOURS

PMF DERIVATION HIGHLAND LAKE DAM
Probable Maximum Precipitation

SHEET NO. ____ OF ____
JOB NO. ____
BY YIN DATE July 1978

PROBABLE MAXIMUM FLOOD CALCULATION (PMF)

DRAINAGE = 0.76 Sq. mi.

From Hydrometeorological Report "33" Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Duration of 6, 12, 24 and 48 Hours" 1956

For D.A. = 10 sq. mi.
6 hour rain fall duration.
PMP = 25.0" for Zone "6" at this Basin.

Since D.A. < 10 sq mi. No area reduction to be applied.
PMP values for varies rain fall duration

Duration	PMP (inch)	
6 Hr	1.0 ×	= 25.0"
12 Hr	1.09 ×	= 27.25
24 Hr	1.17 ×	= 29.25
48 Hr.	1.26 ×	= 31.50

PMP values are reduced by 20% to account for misalignment of Basin and storm Isohyetal.

Duration	PMP
6 Hr	20.0"
12 Hr	21.8"
24 Hr	23.4"
48 Hr	25.2"

Can be neglected.

ECI-4 ENGINEERING CONSULTANTS, INC.

NEW JERSEY DAM SAFETY INSPECTION (DSP)
PMF DERIVATION - HIGHLAND LAKE DAM
PROBABLE MAXIMUM PRECIPITATION

SHEET NO. ____ OF ____
JOB NO. 1212
BY YIN DATE ____

0.76 SQ. mi

PMP. PMF DERIVATION:

1) SOIL GROUP "C", & AMC = II.

2). CN = 85.

MIN LOSS RATE FOR ABOVE CONDITION IS 0.12"/hr
or 0.04"/⅛ hr

FOR CN = 85,

S = 1.76 in the

EQ. $Q = (P - 0.2S)^2 / P + 0.8S$.

or $Q = (P - 0.362)^2 / P + 1.408$.

ECI-4 ENGINEERING CONSULTANTS, INC.

NEW JERSEY DAM SAFETY INSPECTION - REP SHEET NO. 1 OF
PMF DERIVATION - HIGHLAND LAKE DAM JOB NO. 1212-001-1
DIRECT RUNOFF BY KLB DATE 7-21-78
GM

DIRECT RUNOFF INCREMENTS FOR COMPUTING - PMF

	TIME ENDING (HR)	INCREMENTAL DESIGN RAINFALL (IN)	ACCUMULATIVE DESIGN RAINFALL (IN)	DIRECT RUNOFF ACCUMULATIVE (IN)	DIRECT RUNOFF INCREMENTAL (IN)	INCREMENTAL LOSS (IN)
	0.10	0.20	0.20	0.00	0.00	0.00
	0.20	0.20	0.40	0.00	0.00	0.00
	0.30	0.20	0.60	0.03	0.00	0.03
	0.40	0.20	0.80	0.09	0.06	0.14
	0.50	0.20	1.00	0.17	0.08	0.12
	0.60	0.20	1.20	0.28	0.11	0.09
	0.70	0.20	1.40	0.39	0.11	0.09
	0.80	0.20	1.60	0.52	0.13	0.07
	0.90	0.20	1.80	0.65	0.13	0.07
2.0	1.00	0.20	2.00	0.80	0.15	0.05
	1.10	0.24	2.24	0.98	0.18	0.06
	1.20	0.24	2.48	1.16	0.18	0.06
	1.30	0.24	2.72	1.36	0.20	0.04
	1.40	0.24	2.96	1.56	0.20	0.04
	1.50	0.24	3.20	1.76	0.20	0.04
	1.60	0.24	3.44	1.97	0.21	0.03
	1.70	0.24	3.68	2.18	0.21	0.03
	1.80	0.24	3.92	2.39	0.21	0.03
	1.90	0.24	4.16	2.60	0.21	0.03
2.4	2.00	0.24	4.40	2.82	0.22	0.02
	2.10	0.30	4.70	3.10	0.28	0.02
	2.20	0.30	5.00	3.37	0.27	0.03
	2.30	0.30	5.30	3.65	0.28	0.02
	2.40	0.30	5.60	3.93	0.28	0.02
	2.50	0.30	5.90	4.21	0.28	0.02
	2.60	0.30	6.20	4.50	0.29	0.01*
	2.70	0.30	6.50	4.78	0.29	0.01
	2.80	0.30	6.80	5.07	0.29	0.01
	2.90	0.30	7.10	5.35	0.29	0.01
3.0	3.00	0.30	7.40	5.64	0.29	0.01

* MINIMUM LOSS RATE = 0.12"/HR = 0.012"/.1HR SAY 0.01"/.1HR
AFTER THIS RATE IS REACHED, ABANDON CURVE FOR CONSTANT LOSS)

ENGINEERING CONSULTANTS, INC.

NEW JERSEY DAM SAFETY INSPECTION - (DEP) SHEET NO. 2 OF ____
PMF DERIVATION — HIGHLAND LAKE DAM JOB NO. 1212-001-1
DIRECT RUNOFF CONT. BY KLB DATE 7-24-

DIRECT RUNOFF INCREMENTS FOR COMPUTING - PMF

TIME ENDING (HR)	INCREMENTAL DESIGN RAINFALL (IN)	ACCUMULATIVE DESIGN RAINFALL (IN)	DIRECT RUNOFF ACCUMULATIVE (IN)	DIRECT RUNOFF INCREMENTAL (IN)	INCREMENTAL LOSS (IN)
3.10	0.75	8.15	6.36	0.74	0.01
3.20	0.75	8.90	7.09	0.74	0.01
3.30	0.75	9.65	7.82	0.74	0.01
3.40	0.75	10.40	8.55	0.74	0.01
3.50	0.75	11.15	9.28	0.74	0.01
3.60	0.90	12.05	10.17	0.89	0.01
3.70	0.75	12.80	10.91	0.74	0.01
3.80	0.75	13.55	11.65	0.74	0.01
3.90	0.75	14.30	12.39	0.74	0.01
4.00	0.73	15.03	13.11	0.72	0.01
4.10	0.28	15.31	13.38	0.27	0.01
4.20	0.28	15.59	13.66	0.27	0.01
4.30	0.28	15.87	13.94	0.27	0.01
4.40	0.28	16.15	14.21	0.27	0.01
4.50	0.28	16.43	14.49	0.27	0.01
4.60	0.28	16.71	15.00	0.27	0.01
4.70	0.28	16.99	15.05	0.27	0.01
4.80	0.28	17.27	15.32	0.27	0.01
4.90	0.28	17.55	15.84	0.27	0.01
5.00	0.28	17.83	15.88	0.27	0.01
5.10	0.22	18.05	16.10	0.21	0.01
5.20	0.22	18.27	16.32	0.21	0.01
5.30	0.22	18.49	16.53	0.21	0.01
5.40	0.22	18.71	16.75	0.21	0.01
5.50	0.22	18.99	17.03	0.21	0.01
5.60	0.22	19.15	17.19	0.21	0.01
5.70	0.22	19.37	17.41	0.21	0.01
5.80	0.22	19.59	17.63	0.21	0.01
5.90	0.22	19.81	17.84	0.21	0.01
6.00	0.22	20.03	18.06	0.21	0.01

* MINIMUM LOSS RATE = 0.12"/HR = 0.012"/.1 HR SAY 0.01"/.1HR
(AFTER THIS RATE IS REACHED, ABANDON CURVE FOR CONSTANT LOSSES)

HEC-1 - COMPUTATIONS

ENGINEERING CONSULTANTS, INC.

NEW JERSEY DAM SAFETY INSPECTION - (DEP) SHEET NO. 1 OF
INPUT FOR HEC-1, HIGHLAND LAKE DAM JOB NO. 212-001-1
Y2 - Y3 CARD DATA BY MLB DATE 2-21-78

INPUT TO HEC-1 (FROM CURVES)

	#	ELEV (FT)	Y2 STORAGE (AC-FT)	Y3 DISCHARGE (CFS)
SPILLWAY CREST	1	235.22	49.0	0.
	2	235.87	52.8	100.
	3	236.52	56.5	400.
	4	237.17	60.4	840.
	5	237.50	62.5	1100.
TOP OF DAM	6	237.82	64.5	1400.
	7	238.20	66.6	1770.
	8	238.50	68.5	2100.
	9	239.00	71.4	2660.
	10	240.00	77.2	4000.

****
HEC-1 VERSION DATED JAN 1973

****

DAM SAFETY INSPECTION - NEW JERSEY STATE
HIGHLAND LAKE DAM
PMF FLOOD ROUTING

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
80	0	6	0	0	0	0	0	0	0

JOPER NWT
3 0

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SUB-AREA RUNOFF COMPUTATION

INPUT UNIT HYDROGRAPH DERIVED FROM SCS METHOD

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
5	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	0.76	0.00	0.76	0.00	0.000	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
60	0.00	0.00	0.00

PRECIP PATTERN

0.00	0.00	0.00	0.06	0.08	0.11	0.11	0.13	0.13	0.15
0.18	0.18	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.22
0.28	0.27	0.28	0.28	0.28	0.29	0.29	0.29	0.29	0.29
0.74	0.74	0.74	0.74	0.74	0.89	0.74	0.74	0.74	0.74
0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

GIVEN UNIT GRAPH, NUHGQ= 11

0.	625.	1752.	1250.	625.	325.	150.	75.	30.	5.
0.								

UNIT GRAPH TOTALS 4837. CFS OR 0.98 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.00	0.00	0.
2	0.00	0.00	0.
3	0.00	0.00	0.
4	0.06	0.06	0.

5	0.08	0.08	37.
6	0.11	0.11	155.
7	0.11	0.11	283.
8	0.13	0.13	398.
9	0.13	0.13	480.
10	0.15	0.15	550.
11	0.18	0.18	605.
12	0.18	0.18	679.
13	0.20	0.20	766.
14	0.20	0.20	832.
15	0.20	0.20	894.
16	0.21	0.21	933.
17	0.21	0.21	957.
18	0.21	0.21	984.
19	0.21	0.21	1001.
20	0.22	0.22	1009.
21	0.28	0.28	1019.
22	0.27	0.27	1075.
23	0.28	0.28	1188.
24	0.28	0.28	1258.
25	0.28	0.28	1304.
26	0.29	0.29	1331.
27	0.29	0.29	1350.
28	0.29	0.29	1374.
29	0.29	0.29	1389.
30	0.29	0.29	1396.
31	0.74	0.74	1400.
32	0.74	0.74	1682.
33	0.74	0.74	2472.
34	0.74	0.74	3054.
35	0.74	0.74	3316.
36	0.89	0.89	3462.
37	0.74	0.74	3623.
38	0.74	0.74	3826.
39	0.74	0.74	3764.
40	0.74	0.74	3673.
41	0.27	0.27	3628.
42	0.27	0.27	3308.
43	0.27	0.27	2473.
44	0.27	0.27	1879.
45	0.27	0.27	1581.
46	0.27	0.27	1428.
47	0.27	0.27	1357.
48	0.27	0.27	1322.
49	0.27	0.27	1308.
50	0.27	0.27	1305.
51	0.21	0.21	1305.
52	0.21	0.21	1268.
53	0.21	0.21	1163.
54	0.21	0.21	1088.
55	0.21	0.21	1050.
56	0.21	0.21	1031.
57	0.21	0.21	1022.
58	0.21	0.21	1017.
59	0.21	0.21	1016.
60	0.21	0.21	1015.
61	0.00	0.00	1015.
62	0.00	0.00	884.
63	0.00	0.00	516.
64	0.00	0.00	254.
65	0.00	0.00	122.

66	0.00	0.00	54.
67	0.00	0.00	23.
68	0.00	0.00	7.
69	0.00	0.00	1.
70	0.00	0.00	0.
71	0.00	0.00	0.
72	0.00	0.00	0.
73	0.00	0.00	0.
74	0.00	0.00	0.
75	0.00	0.00	0.
76	0.00	0.00	0.
77	0.00	0.00	0.
78	0.00	0.00	0.
79	0.00	0.00	0.
80	0.00	0.00	0.
SUM	17.98	17.98	86965.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3826.	1447.	1087.	1087.	86969.
INCHES		17.71	17.74	17.74	17.74
AC.FT		718.	719.	719.	719.

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH HIGHLAND LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
5	1	0	0	2	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.000	0.00	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
0	0	0	0.000	0.000	0.000	-1.

STORAGE=	49.	52.	56.	60.	62.	64.	66.	68.	71.	77.
OUTFLOW=	0.	100.	400.	840.	1100.	1400.	1770.	2100.	2660.	4000.

TIME	EOP STOR	AVG IN	EOP OUT
1	49.	0.	0.
2	49.	0.	0.
3	49.	0.	0.
4	49.	0.	0.
5	49.	18.	3.
6	49.	96.	21.
7	51.	219.	60.
8	53.	341.	140.
9	55.	439.	290.
10	56.	515.	404.
11	57.	577.	514.
12	58.	642.	595.
13	58.	722.	676.
14	59.	799.	754.
15	60.	863.	824.
16	60.	918.	883.

17	61.	945.	925.
18	61.	971.	956.
19	61.	993.	981.
20	61.	1005.	997.
21	61.	1014.	1008.
22	61.	1047.	1035.
23	62.	1131.	1100.
24	63.	1223.	1194.
25	63.	1281.	1260.
26	63.	1317.	1304.
27	64.	1340.	1332.
28	64.	1362.	1355.
29	64.	1382.	1375.
30	64.	1393.	1389.
31	64.	1398.	1396.
32	65.	1541.	1518.
33	67.	2077.	1987.
34	71.	2753.	2660.
35	73.	3175.	3163.
36	74.	3589.	3384.
37	75.	3543.	3539.
38	75.	3725.	3720.
39	76.	3795.	3793.
40	75.	3718.	3720.
41	75.	3650.	3652.
42	74.	3468.	3472.
43	72.	2890.	2904.
44	69.	2176.	2235.
45	66.	1730.	1805.
46	65.	1504.	1552.
47	64.	1392.	1418.
48	64.	1340.	1356.
49	64.	1315.	1325.
50	63.	1307.	1311.
51	63.	1305.	1307.
52	63.	1287.	1291.
53	63.	1215.	1233.
54	62.	1125.	1151.
55	62.	1069.	1090.
56	62.	1041.	1056.
57	61.	1026.	1036.
58	61.	1020.	1025.
59	61.	1016.	1019.
60	61.	1015.	1017.
61	61.	1015.	1016.
62	61.	950.	971.
63	59.	700.	791.
64	57.	585.	533.
65	55.	188.	332.
66	54.	88.	209.
67	53.	38.	124.
68	52.	15.	88.
69	51.	4.	71.
70	51.	0.	57.
71	50.	0.	46.
72	50.	0.	37.
73	50.	0.	29.
74	49.	0.	24.
75	49.	0.	19.
76	49.	0.	15.
77	49.	0.	12.

78	49.	0.	10.		
79	49.	0.	8.		
80	49.	0.	6.		
SUM			86942.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3793.	1440.	1086.	1086.	86942.
INCHES		17.63	17.73	17.73	17.73
AC-FT		714.	718.	718.	718.

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	5	3826.	1447.	1087.	1087.	0.76
ROUTED TO	5	3793.	1440.	1086.	1086.	0.76

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HEC-1 VERSION DATED JAN 1973

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DAM SAFETY INSPECTION - NEW JERSEY STATE
HIGHLAND LAKE DAM
ONE HALF PMF FLOOD ROUTING

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
80	0	6	0	0	0	0	0	0	0

JOPER	NWT
3	0

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SUB-AREA RUNOFF COMPUTATION

INPUT UNIT HYDROGRAPH DERIVED FROM SCS METHOD

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
5	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	0.76	0.00	0.76	0.00	0.500	0	0	0

PRECIP DATA

NP	STORM	DAD	DAK
60	0.00	0.00	0.00

PRECIP PATTERN

0.00	0.00	0.00	0.06	0.08	0.11	0.11	0.13	0.13	0.15
0.18	0.18	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.22
0.28	0.27	0.28	0.28	0.28	0.29	0.29	0.29	0.29	0.29
0.74	0.74	0.74	0.74	0.74	0.89	0.74	0.74	0.74	0.74
0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

GIVEN UNIT GRAPH, NUMGQ= 11

0.	625.	1732.	1250.	625.	325.	150.	75.	30.	5.
0.									

UNIT GRAPH TOTALS 4837. CFS OR 0.98 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.00	0.00	0.
2	0.00	0.00	0.
3	0.00	0.00	0.
4	0.06	0.06	0.

1901 SOUTH NAVAJO, DENVER, COLORADO 80223

5	0.08	0.08	37.
6	0.11	0.11	155.
7	0.11	0.11	283.
8	0.13	0.13	398.
9	0.13	0.13	480.
10	0.15	0.15	550.
11	0.18	0.18	605.
12	0.18	0.18	679.
13	0.20	0.20	766.
14	0.20	0.20	832.
15	0.20	0.20	894.
16	0.21	0.21	933.
17	0.21	0.21	957.
18	0.21	0.21	984.
19	0.21	0.21	1001.
20	0.22	0.22	1009.
21	0.28	0.28	1019.
22	0.27	0.27	1075.
23	0.28	0.28	1188.
24	0.28	0.28	1258.
25	0.28	0.28	1304.
26	0.29	0.29	1331.
27	0.29	0.29	1350.
28	0.29	0.29	1374.
29	0.29	0.29	1389.
30	0.29	0.29	1396.
31	0.74	0.74	1400.
32	0.74	0.74	1682.
33	0.74	0.74	2472.
34	0.74	0.74	3034.
35	0.74	0.74	3316.
36	0.89	0.89	3462.
37	0.74	0.74	3623.
38	0.74	0.74	3826.
39	0.74	0.74	3764.
40	0.74	0.74	3673.
41	0.27	0.27	3628.
42	0.27	0.27	3308.
43	0.27	0.27	2473.
44	0.27	0.27	1879.
45	0.27	0.27	1581.
46	0.27	0.27	1428.
47	0.27	0.27	1357.
48	0.27	0.27	1322.
49	0.27	0.27	1308.
50	0.27	0.27	1305.
51	0.21	0.21	1305.
52	0.21	0.21	1268.
53	0.21	0.21	1165.
54	0.21	0.21	1088.
55	0.21	0.21	1050.
56	0.21	0.21	1031.
57	0.21	0.21	1022.
58	0.21	0.21	1017.
59	0.21	0.21	1016.
60	0.21	0.21	1015.
61	0.00	0.00	1015.
62	0.00	0.00	884.
63	0.00	0.00	516.
64	0.00	0.00	284.
65	0.00	0.00	182.

AD-A060 017 HARRIS ECI ASSOCIATES WOODBRIDGE NJ F/G 13/2
NATIONAL DAM SAFETY PROGRAM. HIGHLAND LAKE DAM (NJ00240), PASSA--ETC(U)
AUG 78 R GERSHOWITZ DACW61-78-C-0124
UNCLASSIFIED NL

2 OF 2
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A060017

END
DATE
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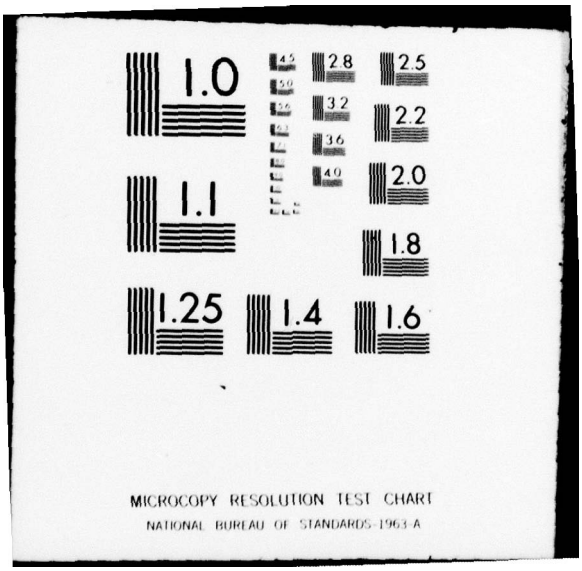
1.0
1.1
1.25
1.4
1.6
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.8
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

66	0.00	0.00	54.
67	0.00	0.00	23.
68	0.00	0.00	7.
69	0.00	0.00	1.
70	0.00	0.00	0.
71	0.00	0.00	0.
72	0.00	0.00	0.
73	0.00	0.00	0.
74	0.00	0.00	0.
75	0.00	0.00	0.
76	0.00	0.00	0.
77	0.00	0.00	0.
78	0.00	0.00	0.
79	0.00	0.00	0.
80	0.00	0.00	0.
SUM	17.98	17.98	86965.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3826.	1447.	1087.	1087.	86969.
INCHES		17.71	17.74	17.74	17.74
AC-FT		718.	719.	719.	719.

RUNOFF MULTIPLIED BY 0.50

0.	0.	0.	0.	18.	77.	141.	199.	240.	275.
302.	339.	383.	416.	447.	466.	478.	492.	500.	504.
509.	537.	594.	629.	652.	665.	675.	687.	694.	698.
700.	841.	1236.	1517.	1658.	1731.	1811.	1913.	1882.	1836.
1814.	1654.	1236.	939.	790.	714.	678.	661.	654.	652.
652.	634.	581.	544.	525.	515.	511.	508.	508.	507.
507.	442.	258.	127.	61.	27.	11.	3.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1913.	725.	543.	543.	43484.
INCHES		8.85	8.87	8.87	8.87
AC-FT		359.	359.	359.	359.

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH HIGHLAND LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
5	1	0	0	2	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.000	0.00	1	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA
0	0	0	0.000	0.000	0.000	-1.

STORAGE=	49.	52.	56.	60.	62.	64.	66.	68.	71.	77.
OUTFLOW=	0.	100.	400.	840.	1180.	1400.	1770.	2100.	2660.	4000.

TIME	EOP STOR	AVG IN	EOP OUT
1	49.	0.	0.

1801 SOUTH NAVAJO, DENVER, COLORADO 80223

2	49.	0.	0.
3	49.	0.	0.
4	49.	0.	0.
5	49.	9.	1.
6	49.	48.	10.
7	50.	109.	30.
8	51.	170.	57.
9	52.	219.	89.
10	53.	257.	157.
11	54.	288.	223.
12	54.	321.	272.
13	55.	361.	317.
14	55.	399.	358.
15	56.	431.	395.
16	56.	456.	433.
17	57.	472.	458.
18	57.	485.	475.
19	57.	496.	488.
20	57.	502.	497.
21	57.	507.	503.
22	57.	523.	516.
23	57.	565.	547.
24	58.	611.	588.
25	58.	640.	621.
26	58.	658.	645.
27	58.	670.	661.
28	58.	681.	673.
29	59.	691.	684.
30	59.	696.	692.
31	59.	699.	696.
32	59.	770.	743.
33	61.	1038.	937.
34	63.	1376.	1252.
35	65.	1587.	1520.
36	66.	1694.	1667.
37	66.	1771.	1755.
38	67.	1862.	1844.
39	67.	1897.	1889.
40	67.	1859.	1864.
41	66.	1825.	1831.
42	66.	1734.	1749.
43	65.	1445.	1493.
44	62.	1088.	1174.
45	61.	865.	956.
46	60.	752.	819.
47	59.	696.	741.
48	59.	670.	695.
49	58.	657.	671.
50	58.	653.	660.
51	58.	652.	655.
52	58.	643.	647.
53	58.	607.	622.
54	58.	562.	584.
55	57.	534.	552.
56	57.	520.	532.
57	57.	513.	520.
58	57.	510.	513.
59	57.	508.	510.
60	57.	507.	508.
61	57.	507.	508.
62	57.	475.	487.

1901 SOUTH NAVAJO, DENVER, COLORADO 80223

63	56.	350.	400.	
64	55.	192.	295.	
65	53.	94.	194.	
66	53.	44.	119.	
67	52.	19.	87.	
68	51.	7.	72.	
69	51.	2.	58.	
70	50.	0.	47.	
71	50.	0.	37.	
72	50.	0.	30.	
73	49.	0.	24.	
74	49.	0.	19.	
75	49.	0.	15.	
76	49.	0.	12.	
77	49.	0.	10.	
78	49.	0.	8.	
79	49.	0.	6.	
80	49.	0.	5.	
SUM			43462.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1889.	718.	543.	543.	43462.
INCHES		8.78	8.86	8.86	8.86
AC-FT		356.	359.	359.	359.

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	5	1913.	723.	543.	543.	0.76
ROUTED TO	5	1889.	718.	543.	543.	0.76

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HEC-1 VERSION DATED JAN 1973

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DAM SAFETY INSPECTION - NEW JERSEY STATE
HIGHLAND LAKE DAM
PERCENT OF PMF FLOOD ROUTING

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
80	0	6	0	0	0	0	0	0	0

JOPER	NWT
3	0

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SUB-AREA RUNOFF COMPUTATION

INPUT UNIT HYDROGRAPH DERIVED FROM SCS METHOD

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
5	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	0.76	0.00	0.76	0.00	0.360	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
60	0.00	0.00	0.00

PRECIP PATTERN

0.00	0.00	0.00	0.06	0.08	0.11	0.11	0.13	0.13	0.15
0.18	0.18	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.22
0.88	0.27	0.28	0.28	0.28	0.29	0.29	0.29	0.29	0.29
0.74	0.74	0.74	0.74	0.74	0.89	0.74	0.74	0.74	0.74
0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

GIVEN UNIT GRAPH, NUHGQ= 11

0.	625.	1752.	1250.	625.	325.	150.	75.	30.	5.
0.									

UNIT GRAPH TOTALS 4857. CFS OR 0.98 INCHES OVER THE AREA

RECESSION DATA

STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.00	0.00	0.
2	0.00	0.00	0.
3	0.00	0.00	0.
4	0.06	0.06	0.

5	0.08	0.08	37.
6	0.11	0.11	155.
7	0.11	0.11	283.
8	0.13	0.13	398.
9	0.13	0.13	480.
10	0.15	0.15	550.
11	0.18	0.18	605.
12	0.18	0.18	679.
13	0.20	0.20	766.
14	0.20	0.20	832.
15	0.20	0.20	894.
16	0.21	0.21	933.
17	0.21	0.21	957.
18	0.21	0.21	984.
19	0.21	0.21	1001.
20	0.22	0.22	1009.
21	0.28	0.28	1019.
22	0.27	0.27	1075.
23	0.28	0.28	1188.
24	0.28	0.28	1258.
25	0.28	0.28	1304.
26	0.29	0.29	1331.
27	0.29	0.29	1350.
28	0.29	0.29	1374.
29	0.29	0.29	1389.
30	0.29	0.29	1396.
31	0.74	0.74	1400.
32	0.74	0.74	1662.
33	0.74	0.74	2472.
34	0.74	0.74	3034.
35	0.74	0.74	3316.
36	0.89	0.89	3462.
37	0.74	0.74	3623.
38	0.74	0.74	3826.
39	0.74	0.74	3764.
40	0.74	0.74	3673.
41	0.27	0.27	3628.
42	0.27	0.27	3308.
43	0.27	0.27	2473.
44	0.27	0.27	1879.
45	0.27	0.27	1581.
46	0.27	0.27	1428.
47	0.27	0.27	1357.
48	0.27	0.27	1322.
49	0.27	0.27	1308.
50	0.27	0.27	1305.
51	0.21	0.21	1305.
52	0.21	0.21	1268.
53	0.21	0.21	1163.
54	0.21	0.21	1088.
55	0.21	0.21	1050.
56	0.21	0.21	1031.
57	0.21	0.21	1022.
58	0.21	0.21	1017.
59	0.21	0.21	1016.
60	0.21	0.21	1015.
61	0.00	0.00	1015.
62	0.00	0.00	884.
63	0.00	0.00	516.
64	0.00	0.00	254.
65	0.00	0.00	122.

66	0.00	0.00	54.
67	0.00	0.00	23.
68	0.00	0.00	7.
69	0.00	0.00	1.
70	0.00	0.00	0.
71	0.00	0.00	0.
72	0.00	0.00	0.
73	0.00	0.00	0.
74	0.00	0.00	0.
75	0.00	0.00	0.
76	0.00	0.00	0.
77	0.00	0.00	0.
78	0.00	0.00	0.
79	0.00	0.00	0.
80	0.00	0.00	0.
SUM	17.98	17.98	86965.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3826.	1447.	1087.	1087.	86969.
INCHES		17.71	17.74	17.74	17.74
AC-FT		718.	719.	719.	719.

RUNOFF MULTIPLIED BY 0.36

0.	0.	0.	0.	13.	55.	102.	143.	173.	198.
217.	244.	275.	299.	322.	335.	344.	354.	360.	363.
366.	387.	427.	453.	469.	479.	486.	494.	500.	502.
504.	605.	889.	1092.	1193.	1246.	1304.	1377.	1355.	1328.
1306.	1190.	890.	676.	569.	514.	488.	476.	471.	470.
470.	456.	418.	391.	378.	371.	368.	366.	365.	365.
365.	318.	185.	91.	44.	19.	8.	2.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1377.	521.	391.	391.	31308.
INCHES		6.37	6.38	6.38	6.38
AC-FT		258.	258.	258.	258.

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH HIGHLAND LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
5	1	0	0	0	0	1

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.000	0.00	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
0	0	0	0.000	0.000	0.000	-1.

STORAGE=	49.	52.	56.	60.	62.	64.	66.	68.	71.	77.
OUTFLOW=	0.	100.	400.	840.	1100.	1400.	1770.	2100.	2660.	4008.

TIME	EOP STOR	AVG IN	EOP OUT
1	49.	0.	0.

EOI
1001 SOUTH NAVAJO DENVER COLORADO 80223

2	49.	0.	0.
3	49.	0.	0.
4	49.	0.	0.
5	49.	6.	1.
6	49.	34.	7.
7	49.	79.	21.
8	50.	122.	41.
9	51.	158.	64.
10	52.	185.	88.
11	53.	207.	130.
12	53.	231.	180.
13	54.	260.	220.
14	54.	287.	254.
15	55.	310.	282.
16	55.	329.	305.
17	55.	340.	323.
18	55.	349.	336.
19	55.	357.	347.
20	55.	361.	354.
21	56.	365.	359.
22	56.	377.	368.
23	56.	407.	388.
24	56.	440.	418.
25	56.	461.	445.
26	57.	474.	463.
27	57.	482.	475.
28	57.	490.	485.
29	57.	497.	493.
30	57.	501.	498.
31	57.	503.	501.
32	57.	554.	555.
33	58.	747.	670.
34	60.	991.	876.
35	62.	1143.	1057.
36	63.	1220.	1176.
37	63.	1275.	1252.
38	63.	1341.	1320.
39	64.	1366.	1355.
40	64.	1338.	1342.
41	63.	1314.	1320.
42	63.	1248.	1265.
43	62.	1040.	1094.
44	60.	783.	883.
45	59.	622.	715.
46	58.	541.	604.
47	57.	501.	539.
48	57.	482.	503.
49	57.	473.	484.
50	57.	470.	475.
51	57.	470.	472.
52	57.	463.	466.
53	56.	457.	448.
54	56.	405.	420.
55	56.	385.	398.
56	56.	374.	386.
57	56.	369.	378.
58	56.	367.	372.
59	56.	366.	369.
60	56.	365.	367.
61	56.	365.	366.
62	55.	348.	354.

1001 SOUTH NAVAJO, DENVER, COLORADO 80223

63	55.	252.	303.	
64	54.	138.	220.	
65	53.	67.	143.	
66	52.	31.	95.	
67	52.	13.	79.	
68	51.	5.	64.	
69	50.	1.	52.	
70	50.	0.	42.	
71	50.	0.	33.	
72	50.	0.	27.	
73	49.	0.	21.	
74	49.	0.	17.	
75	49.	0.	14.	
76	49.	0.	11.	
77	49.	0.	9.	
78	49.	0.	7.	
79	49.	0.	5.	
80	49.	0.	4.	
SUM			31289.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1355.	516.	391.	391.	31289.
INCHES		6.31	6.38	6.38	6.38
AC-FT		256.	258.	258.	258.

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EOI
1901 SOUTH NAVAJO DENVER COLORADO 80223

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	5	1377.	521.	391.	391.	0.76
ROUTED TO	9	1355.	516.	391.	391.	0.76

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: NJ00240	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle): Phase I Inspection Report National Dam Safety Program Highland Lake Dam Passaic County, N.J.	5. TYPE OF REPORT & PERIOD COVERED: (9) FINAL rept.,
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Robert Gershowitz, P.E.	8. CONTRACT OR GRANT NUMBER(s): (15) DACW61-78-C-0124
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Harris-ECI Associates 453 Amboy Ave. Woodbridge, N.J. 07095	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: (12) 197p.
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This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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